US010046438B2

(12) **United States Patent**
Tchakarov

(10) **Patent No.: US 10,046,438 B2**
(45) **Date of Patent: Aug. 14, 2018**

(54) **POLISHING OR GRINDING PAD ASSEMBLY**

(71) Applicant: **DIAMOND TOOL SUPPLY, INC.**, Monroe, MI (US)

(72) Inventor: **Tchavdar V. Tchakarov**, Monroe, MI (US)

(73) Assignee: **Diamond Tool Supply, Inc.**, Monroe, MI (US)

(*) Notice: Subject to any disclaimer, the term of this patent is extended or adjusted under 35 U.S.C. 154(b) by 0 days.

(21) Appl. No.: **15/690,416**

(22) Filed: **Aug. 30, 2017**

(65) **Prior Publication Data**

US 2017/0361423 A1 Dec. 21, 2017

Related U.S. Application Data

(63) Continuation-in-part of application No. PCT/US2016/053355, filed on Sep. 23, 2016.

(60) Provisional application No. 62/232,123, filed on Sep. 24, 2015.

(51) **Int. Cl.**

B24D 7/08	(2006.01)
B24D 18/00	(2006.01)
B24D 11/00	(2006.01)
B24B 7/18	(2006.01)

(52) **U.S. Cl.**

CPC ***B24D 7/08*** (2013.01); ***B24D 11/00*** (2013.01); ***B24D 18/0072*** (2013.01); *B24B 7/186* (2013.01)

(58) **Field of Classification Search**

CPC B24D 7/08; B24D 11/00; B24D 18/0072
USPC 451/526, 527, 538, 539, 353, 359, 449
See application file for complete search history.

(56) **References Cited**

U.S. PATENT DOCUMENTS

2,174,902	A *	10/1939	Stratford	B24D 9/08 451/510
2,225,193	A	12/1940	Benner et al.	
2,425,368	A	8/1947	Doermann	
2,819,568	A *	1/1958	Kasick	B24D 7/10 451/449
3,121,982	A	2/1964	Miller	
3,464,166	A	9/1969	Bouvier	
3,487,589	A *	1/1970	Binkley	B24B 27/06 451/541
3,517,466	A	6/1970	Bouvier	

(Continued)

FOREIGN PATENT DOCUMENTS

DE 202015101442 U1 5/2015

OTHER PUBLICATIONS

Diamond Tool Supply, Inc., "Monroe Floor Polishing Systems," www.diamondtoolsupply.com, published prior to Sep. 24, 2015, 14 pages.

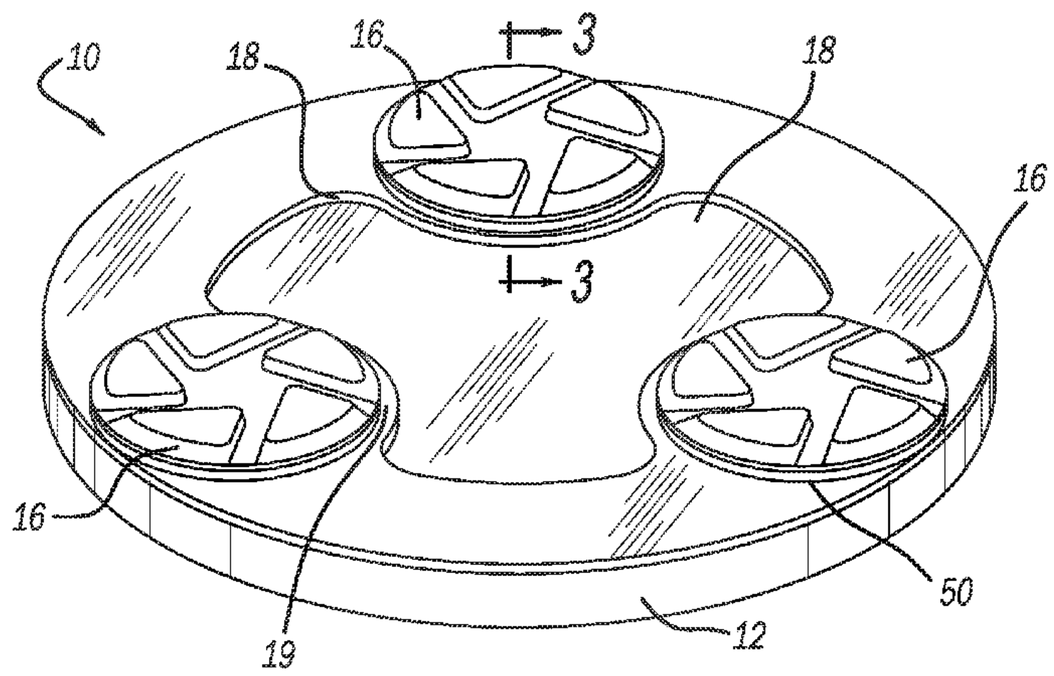
(Continued)

Primary Examiner — George Nguyen
(74) *Attorney, Agent, or Firm* — Harness, Dickey & Pierce, P.L.C.

(57) **ABSTRACT**

A floor polishing or grinding pad assembly is provided. In one aspect, a polishing or grinding pad assembly employs a flexible pad, a reinforcement layer or ring, and multiple floor-contacting tools such as abrasive disks. In another aspect, the reinforcement layer includes a wavy or undulating internal edge shape. A further aspect includes an inner ring edge having radially extending slots between pairs of radially enlarged tool mounting peaks. Still another aspect includes an insulator or spacer between a head of an abrasive tool and a reinforcement ring.

62 Claims, 11 Drawing Sheets



(56) **References Cited**

U.S. PATENT DOCUMENTS

3,934,377	A	1/1976	Tertinek	
4,554,765	A *	11/1985	Grimes	B24D 13/14 451/490
4,694,615	A *	9/1987	MacKay, Jr.	B24B 45/00 451/342
4,724,567	A *	2/1988	Rones	A47L 11/164 15/230.14
4,874,478	A *	10/1989	Ishak	B24D 3/002 204/157.15
5,020,280	A *	6/1991	O'Reilly	B24B 23/02 125/13.01
5,054,245	A	10/1991	Coty	
5,076,023	A	12/1991	Saguchi	
5,247,765	A	9/1993	Quintana	
5,567,503	A	10/1996	Sexton et al.	
5,586,930	A	12/1996	Hayashi et al.	
5,605,493	A	2/1997	Donatelli et al.	
5,632,790	A *	5/1997	Wiand	B24B 7/22 51/293
5,782,682	A	7/1998	Han et al.	
6,196,911	B1	3/2001	Preston et al.	
6,234,886	B1	5/2001	Rivard et al.	
6,298,518	B1 *	10/2001	Umbrell	A47L 11/164 15/230
6,299,522	B1	10/2001	Lee	
7,059,801	B2	6/2006	Snyder et al.	
7,104,739	B2	9/2006	Lagler	
7,147,548	B1 *	12/2006	Mehrabi	B24B 7/186 451/323
7,204,745	B2 *	4/2007	Thysell	A47L 11/164 451/344
D612,874	S	3/2010	Nilsson et al.	
7,670,208	B2	3/2010	Thysell et al.	
7,744,447	B2	6/2010	Kodani et al.	
7,815,393	B2	10/2010	Snyder et al.	
8,147,297	B2	4/2012	Hamm et al.	
8,176,909	B2	5/2012	Ilgner	
8,272,924	B2	9/2012	Van Eijden et al.	
8,464,420	B2	6/2013	Ye	
D743,456	S	11/2015	Shinozaki	
9,174,326	B2	11/2015	Ahonen	
9,925,645	B2	3/2018	Song et al.	
2004/0009744	A1 *	1/2004	Conley	B24D 7/10 451/359
2005/0164620	A1	7/2005	Amamoto	
2007/0254568	A1	11/2007	Park	
2007/0292207	A1	12/2007	Reed et al.	
2009/0190999	A1	7/2009	Copoulos	
2009/0191799	A1 *	7/2009	Rivard	B24D 9/085 451/259
2010/0190421	A1 *	7/2010	Hamm	B24B 7/186 451/353
2011/0053468	A1 *	3/2011	Vontell	B24B 57/02 451/53
2011/0195644	A1 *	8/2011	Gallup	B24B 41/066 451/442
2011/0223845	A1	9/2011	Van Der Veen et al.	
2011/0300784	A1	12/2011	Tchakarov et al.	
2012/0270483	A1	10/2012	Bae et al.	
2013/0225051	A1	8/2013	Vankouwenberg	
2013/0324021	A1	12/2013	Ryan	
2015/0328742	A1 *	11/2015	Schuele	B25F 5/00 451/359
2016/0136772	A1	5/2016	Littlefield et al.	
2016/0144485	A1 *	5/2016	Ruan	B24D 13/147 451/539
2017/0361414	A1 *	12/2017	Tchakarov	B24B 41/047

OTHER PUBLICATIONS

Diamond Tool Supply, Inc., Various polishing and grinding parts, www.diamondtoolsupply.com, published prior to Sep. 24, 2015, 26 pages.

Wagman Metal Products Inc, "Concrete Finishing Tools," www.WagnamMetal.com, published prior to Sep. 14, 2016, 24 pages.

"Confidential/experimental sale from Diamond Tool Supply, Inc. to Wagman Metal Products on Sep. 1, 2016," 2 pages.

ISi GmbH, The System Manufacturer, Brochure Edition 12, Jan. 2017, 83 pages.

"Diamond Tools for Construction Stone," EHWA Diamond Ind. Co. Ltd. Catalogue, Published 2016, 60 pages.

* cited by examiner

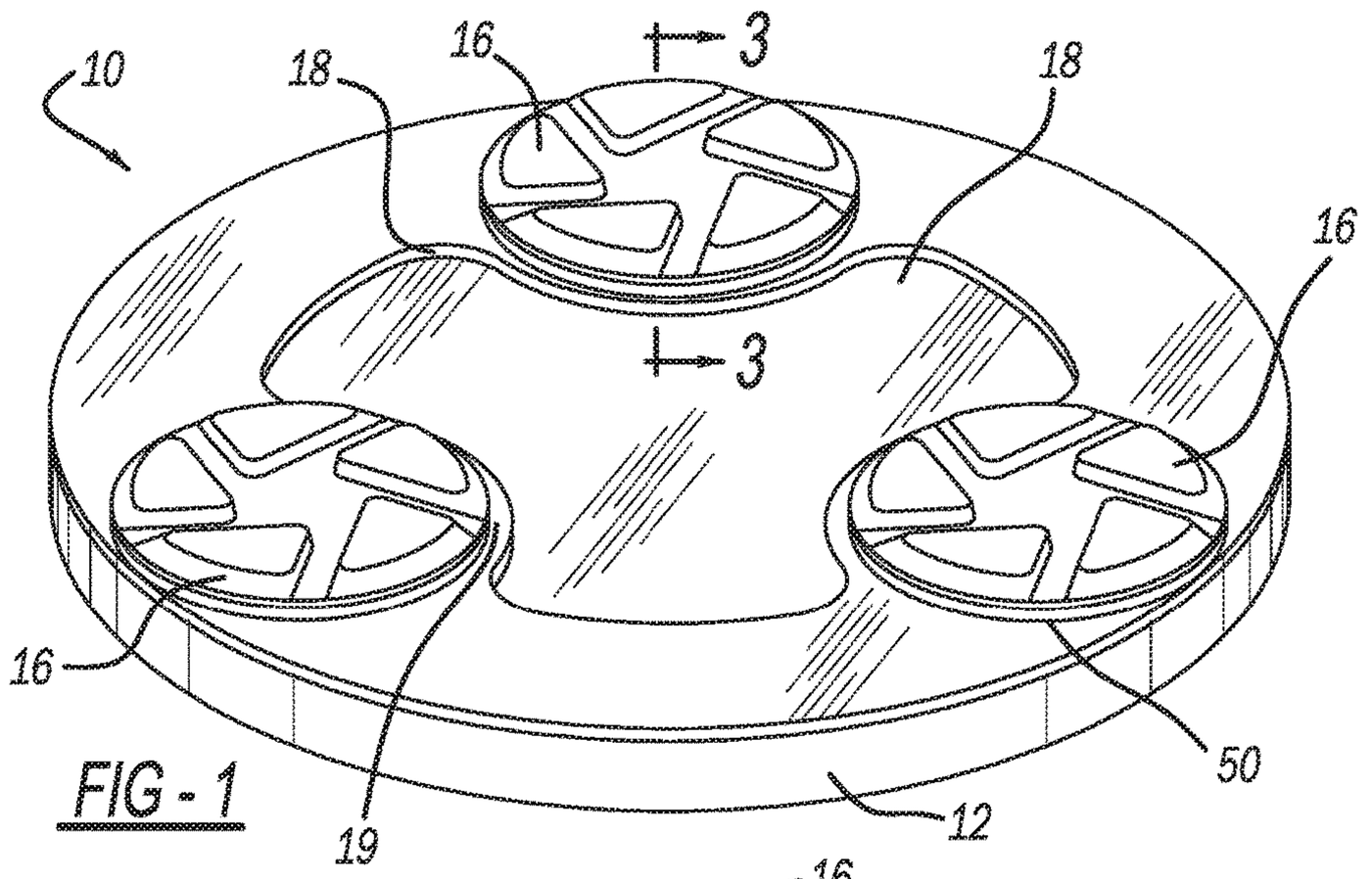

10
18
16
3
3
18
16
16
19
12
50

FIG - 1

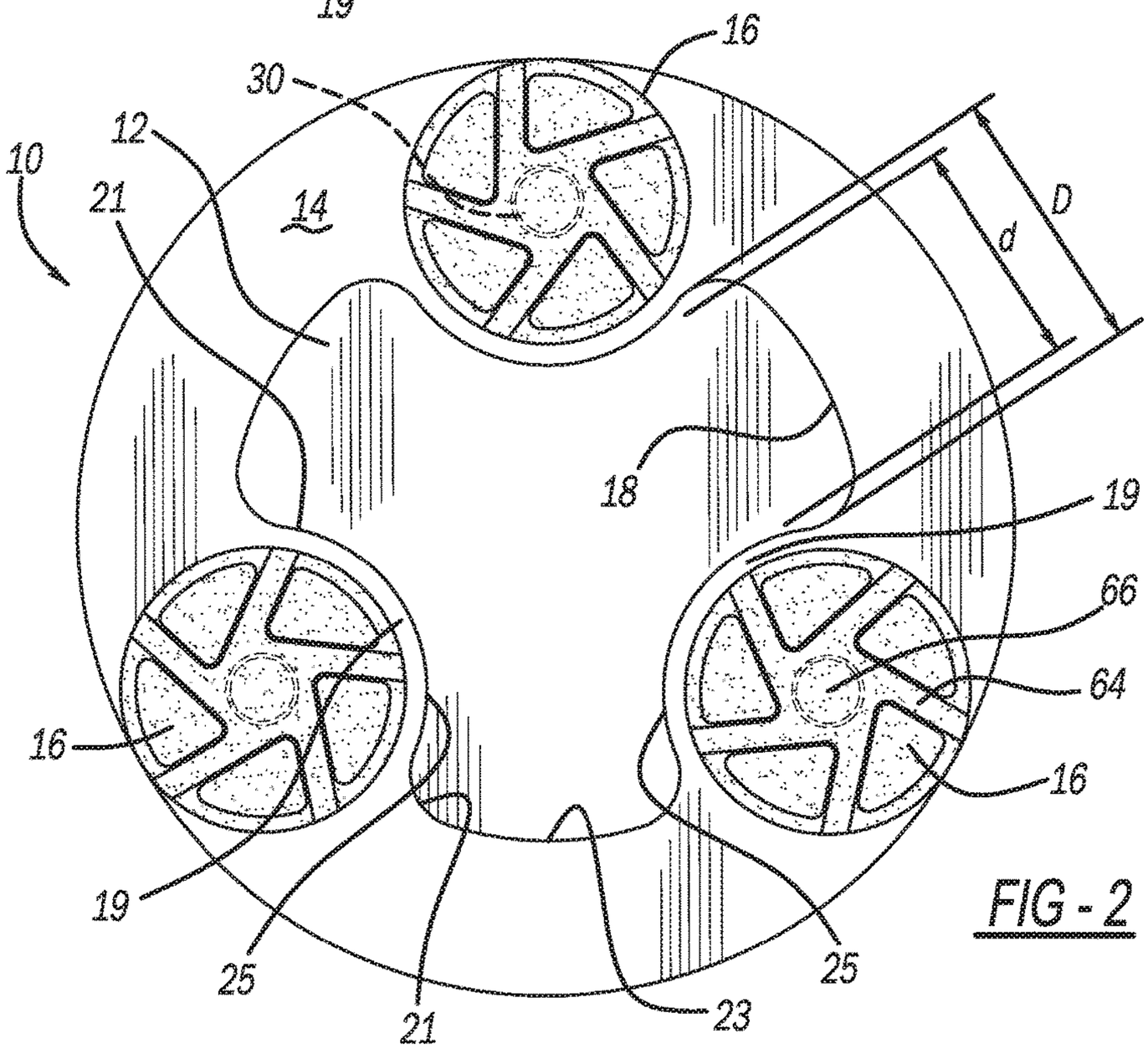

16
30
12
10
21
14
D
d
18
19
66
64
16
16
19
25
21
23
25

FIG - 2

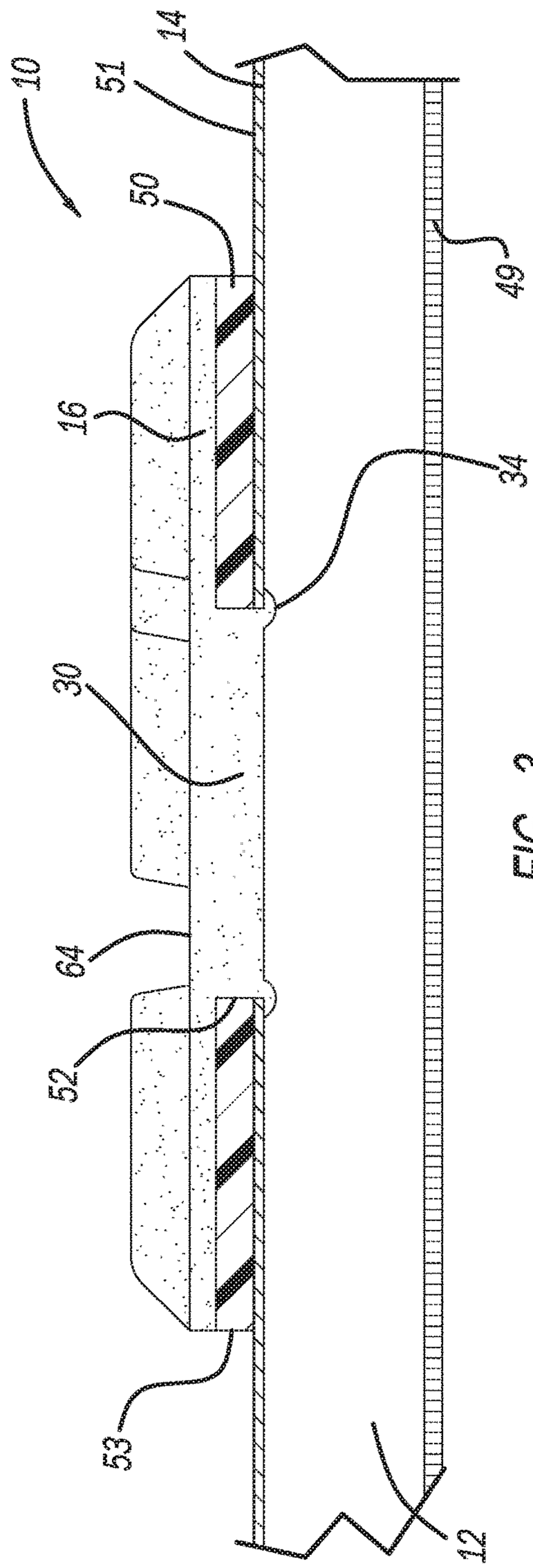


FIG - 3

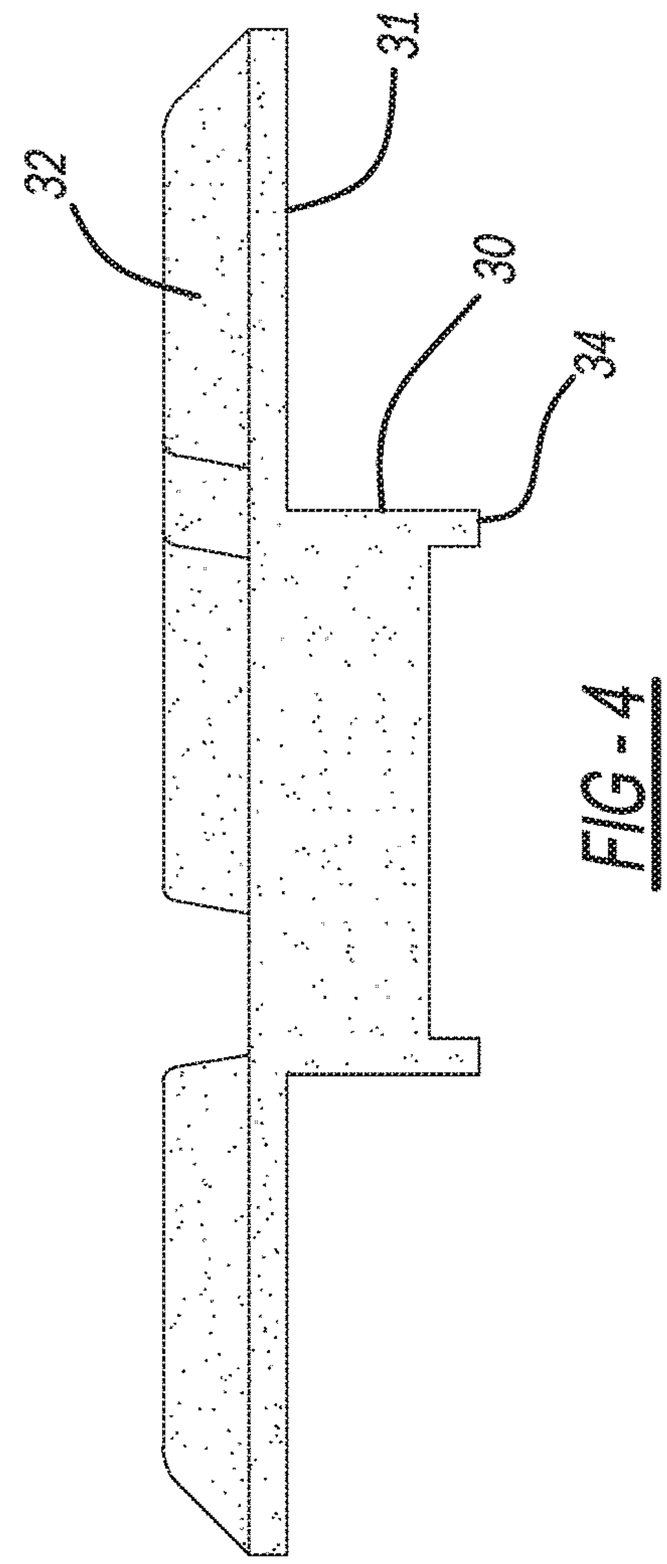


FIG - 4

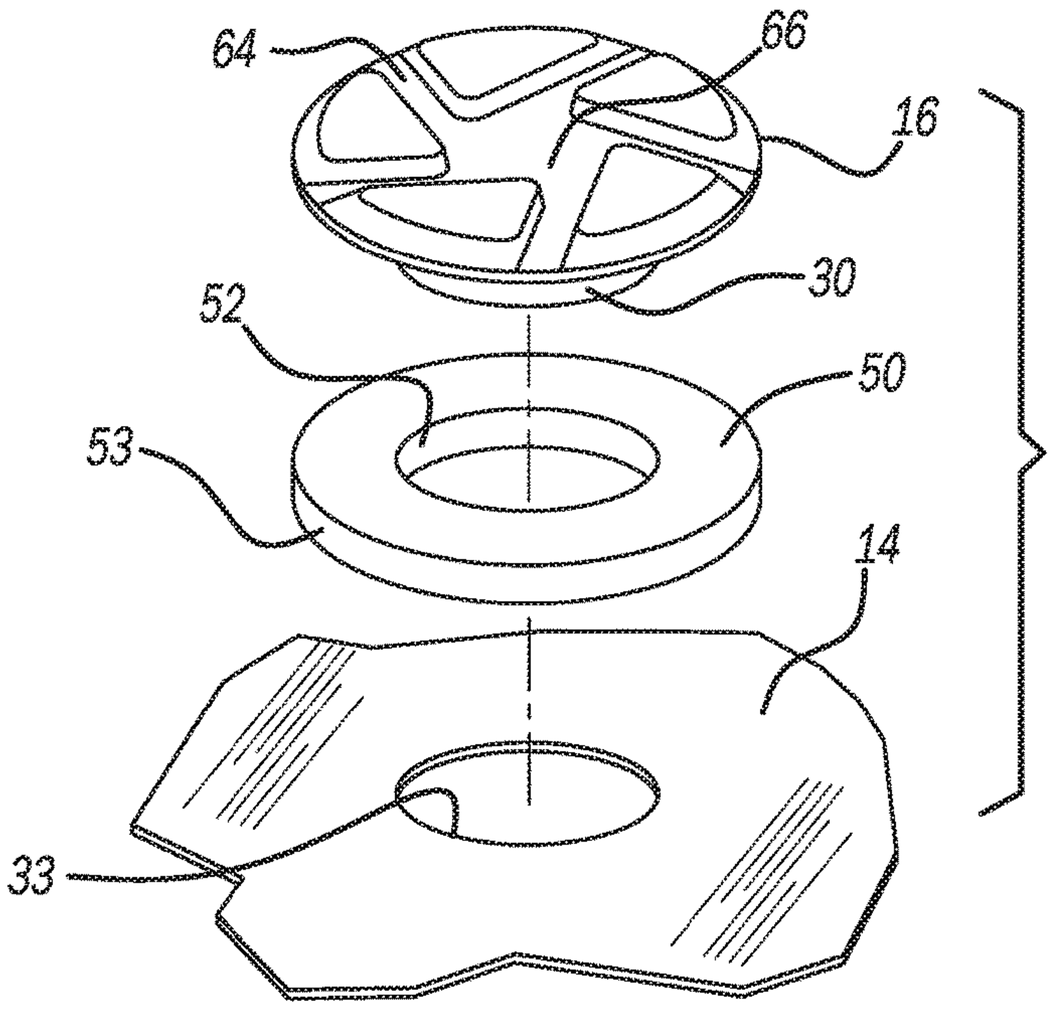


FIG - 5

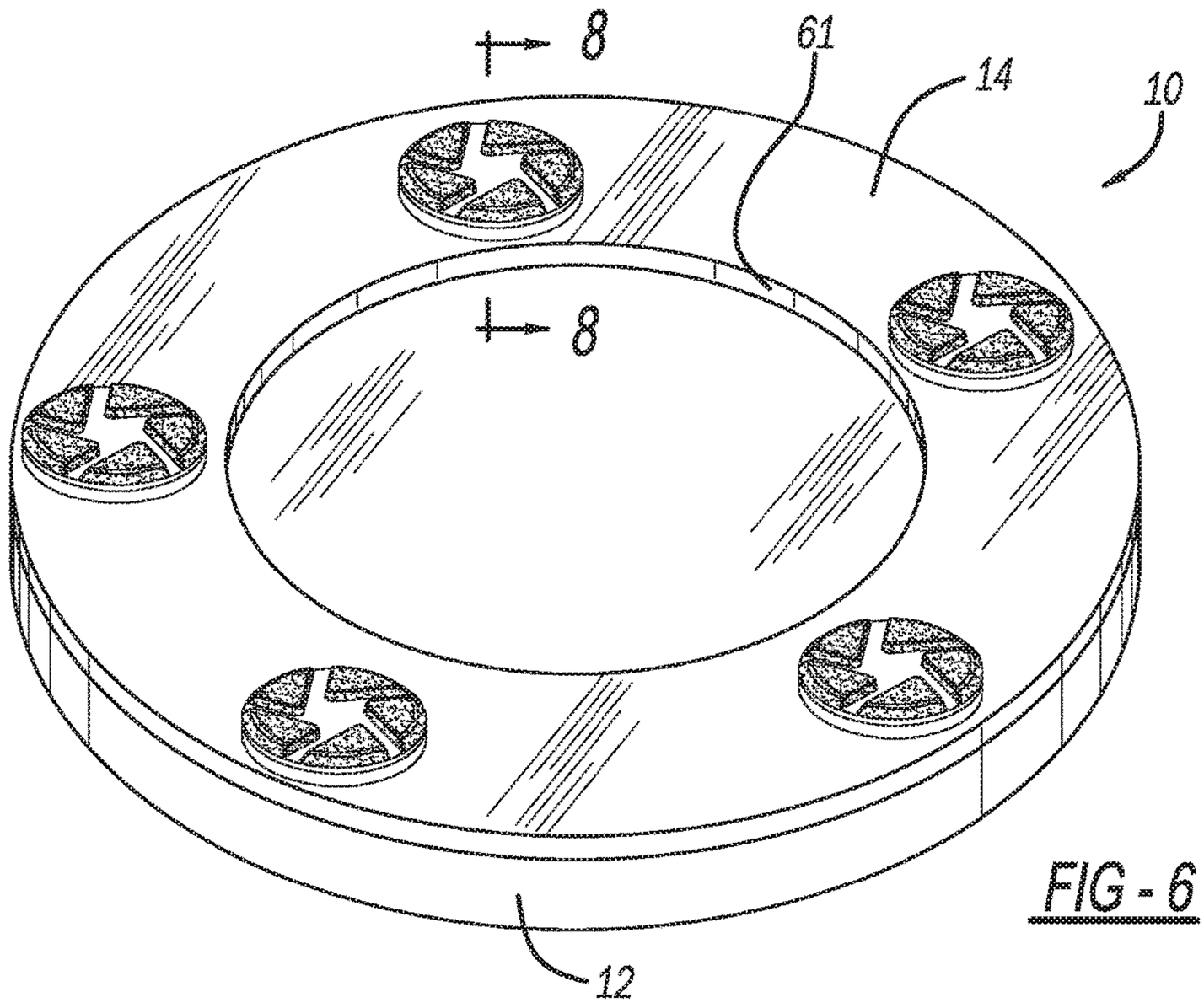


FIG - 6

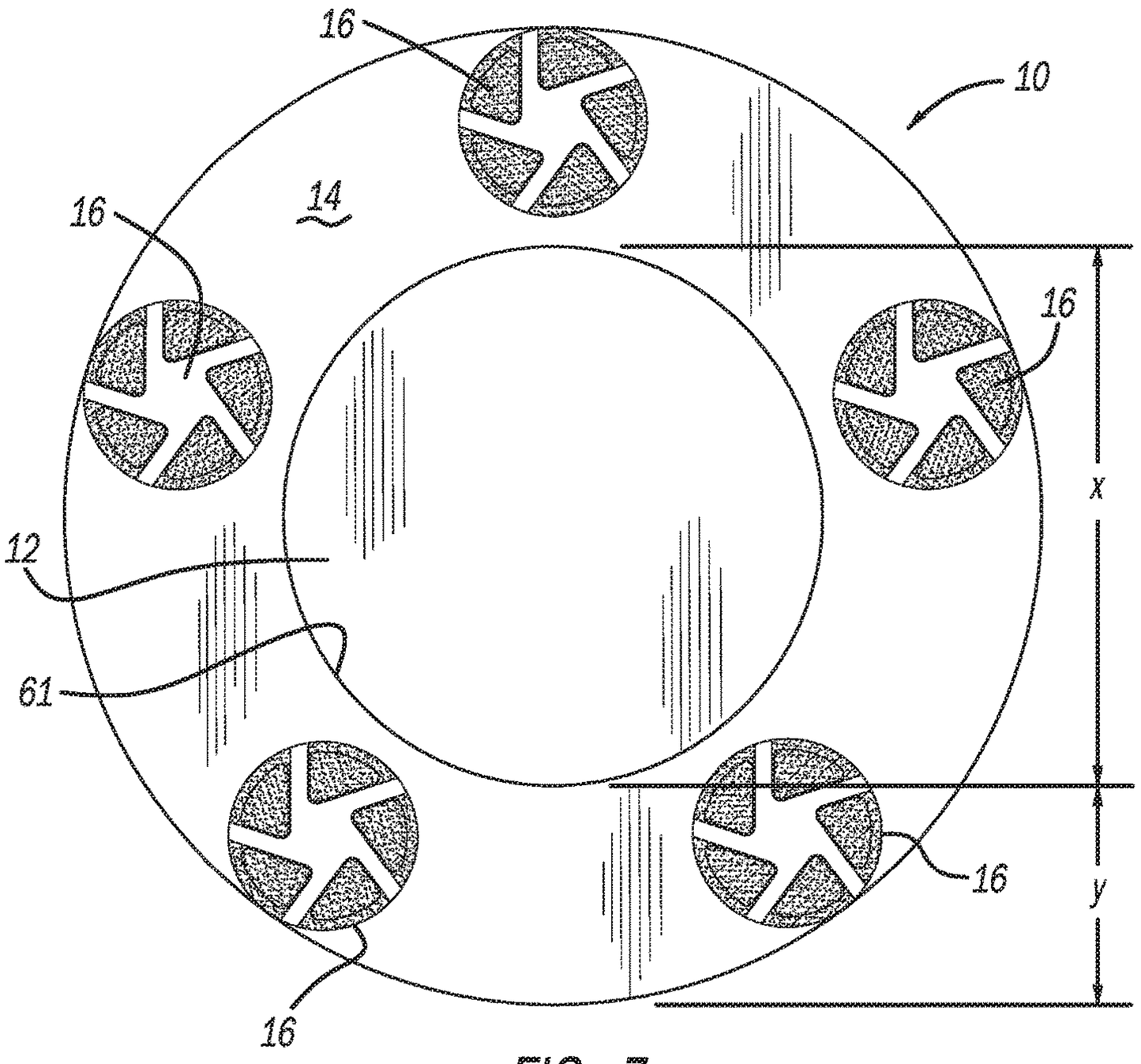


FIG - 7

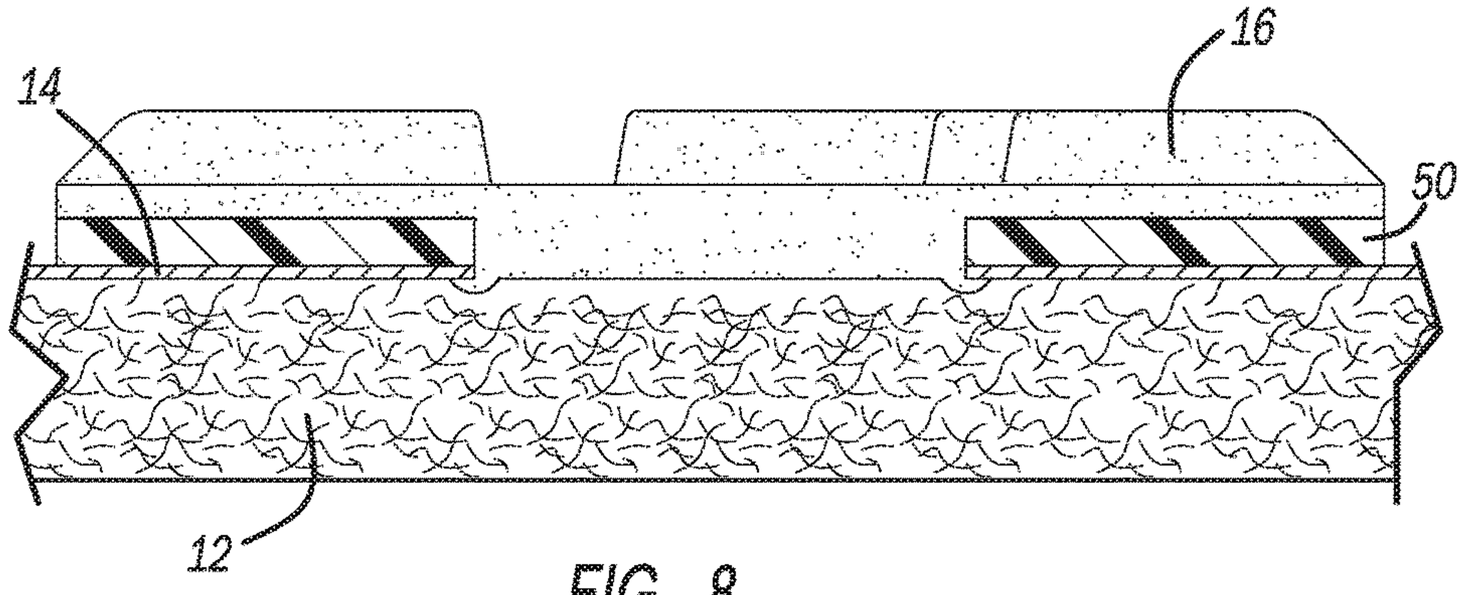


FIG - 8

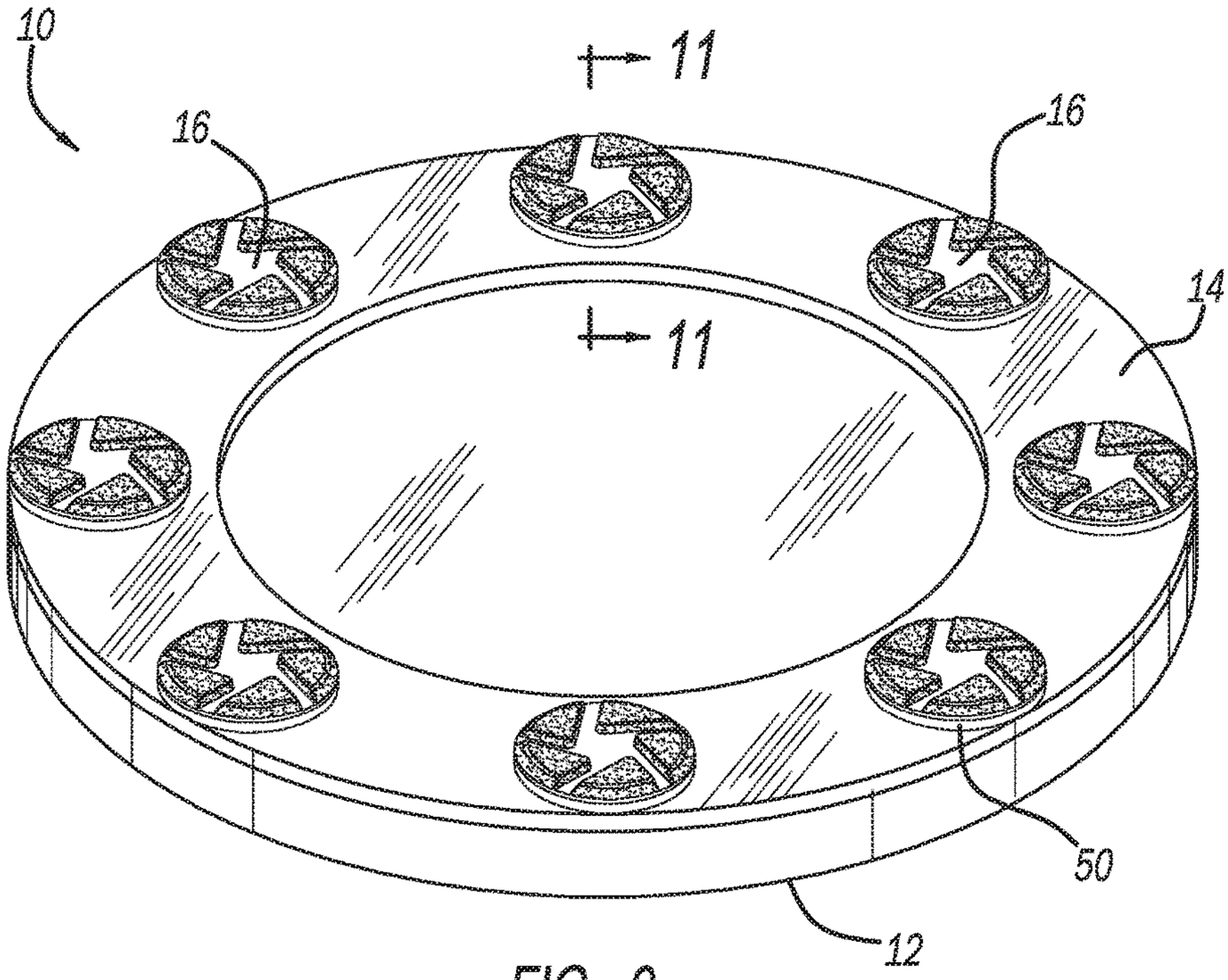


FIG - 9

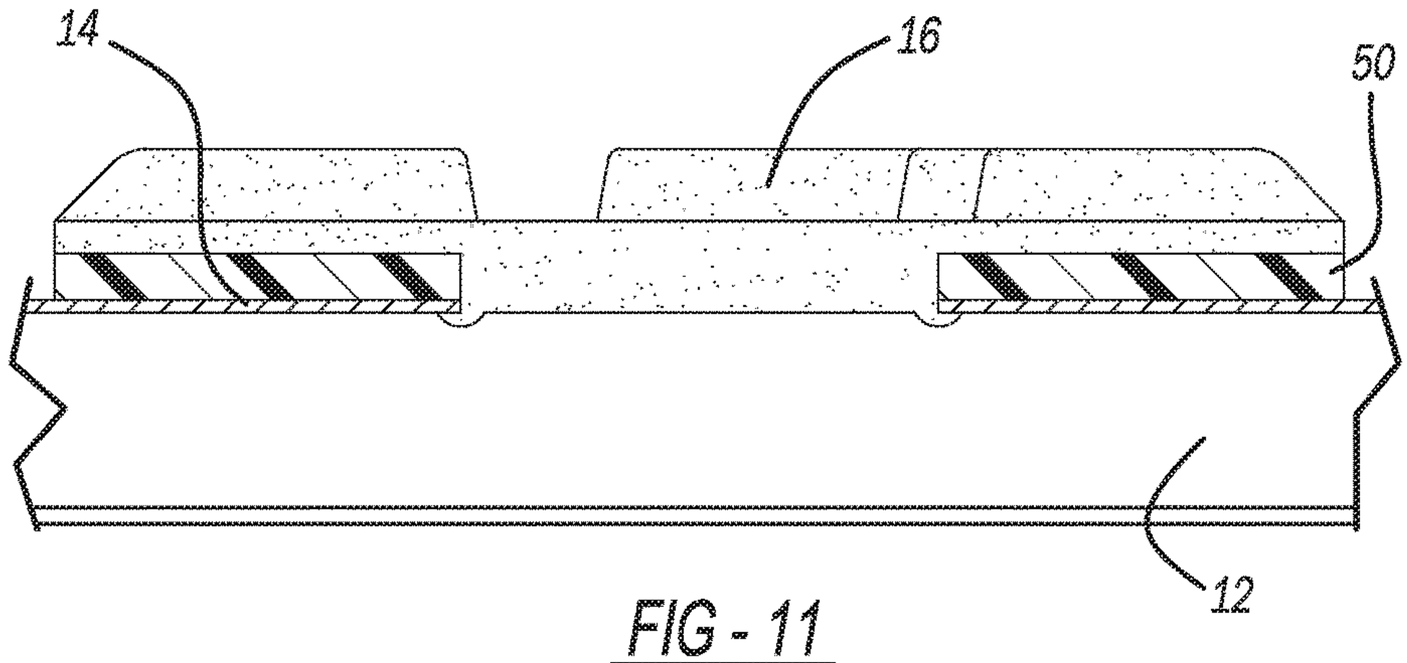


FIG - 11

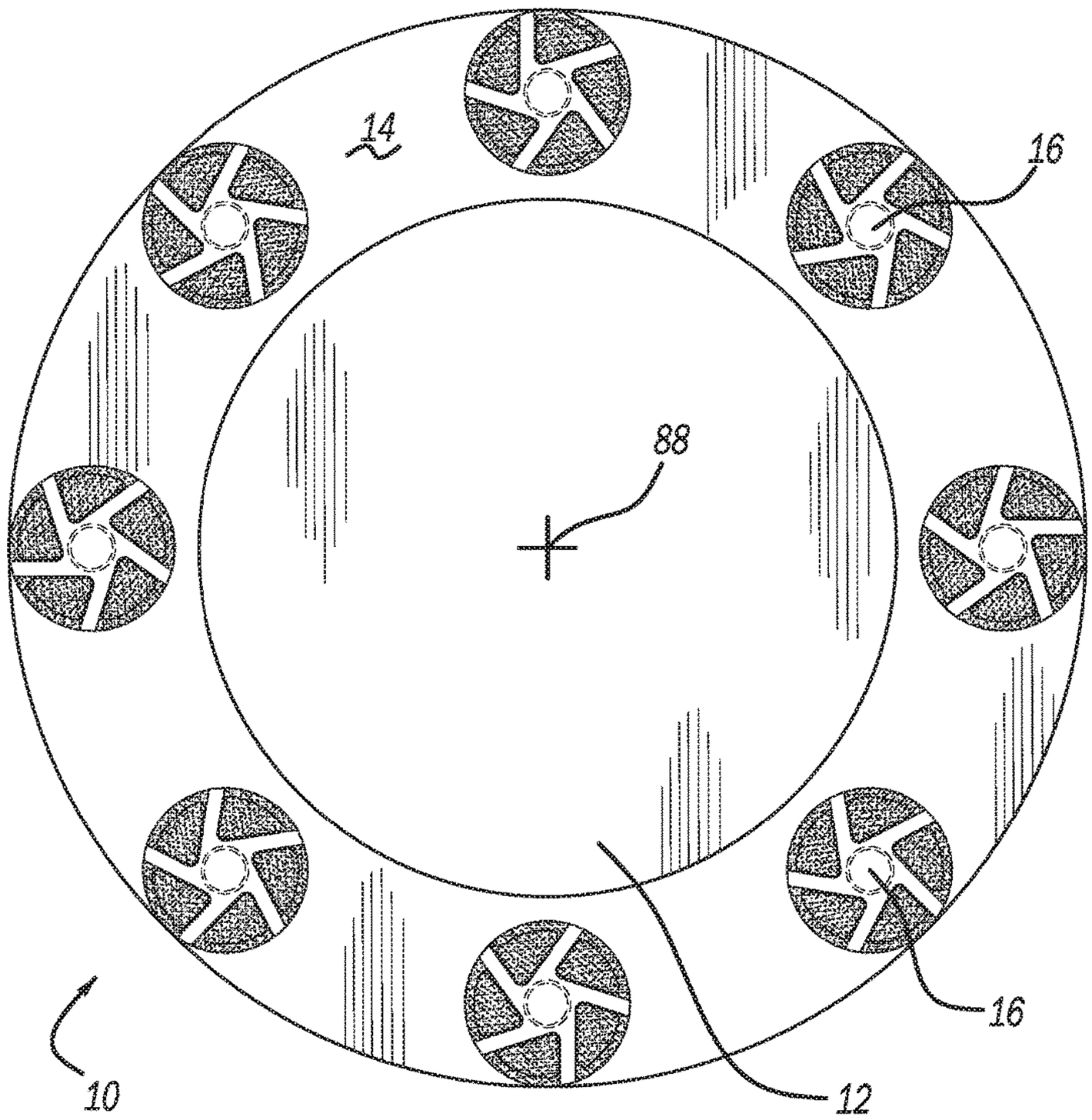


FIG - 10

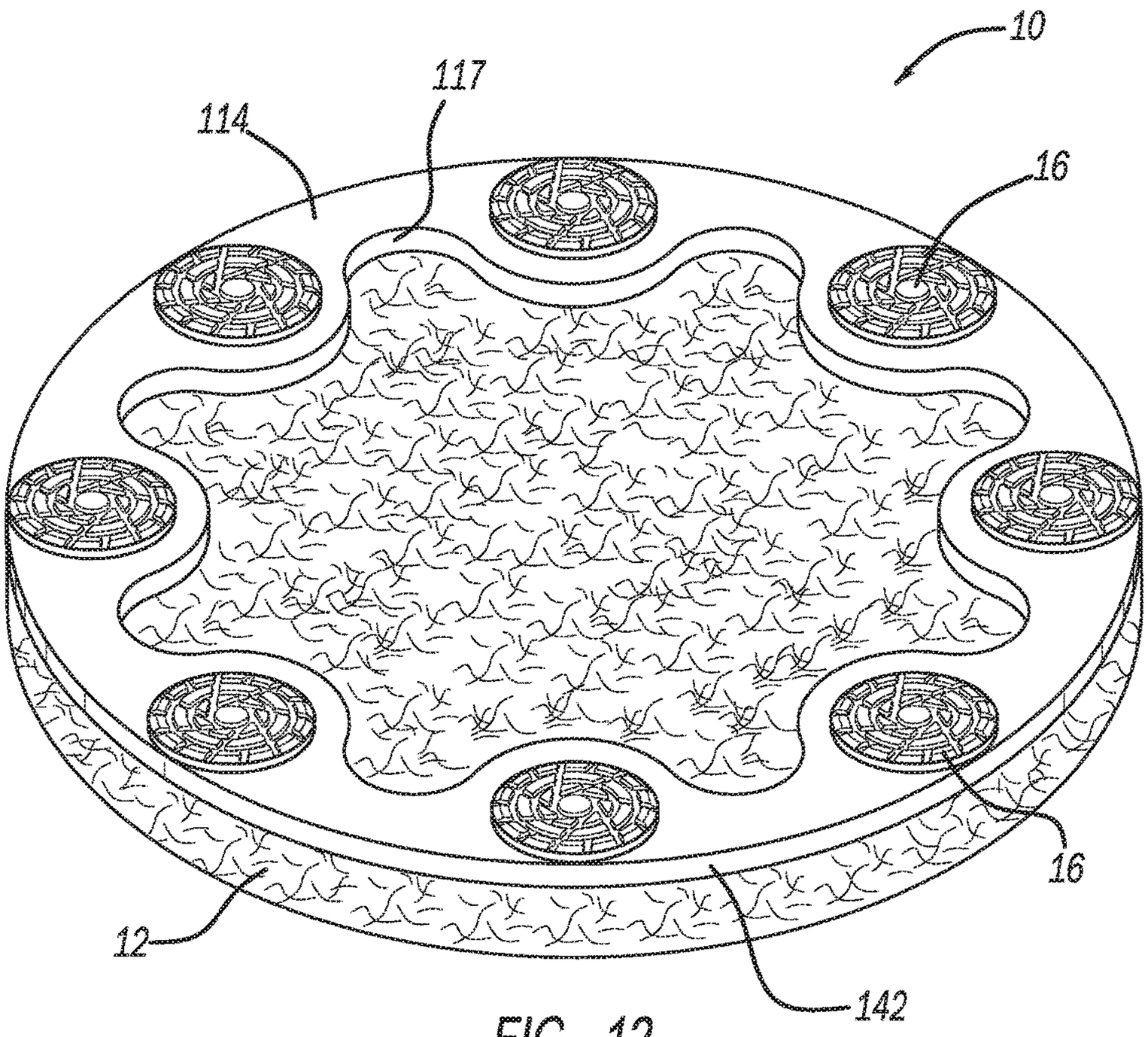


FIG - 12

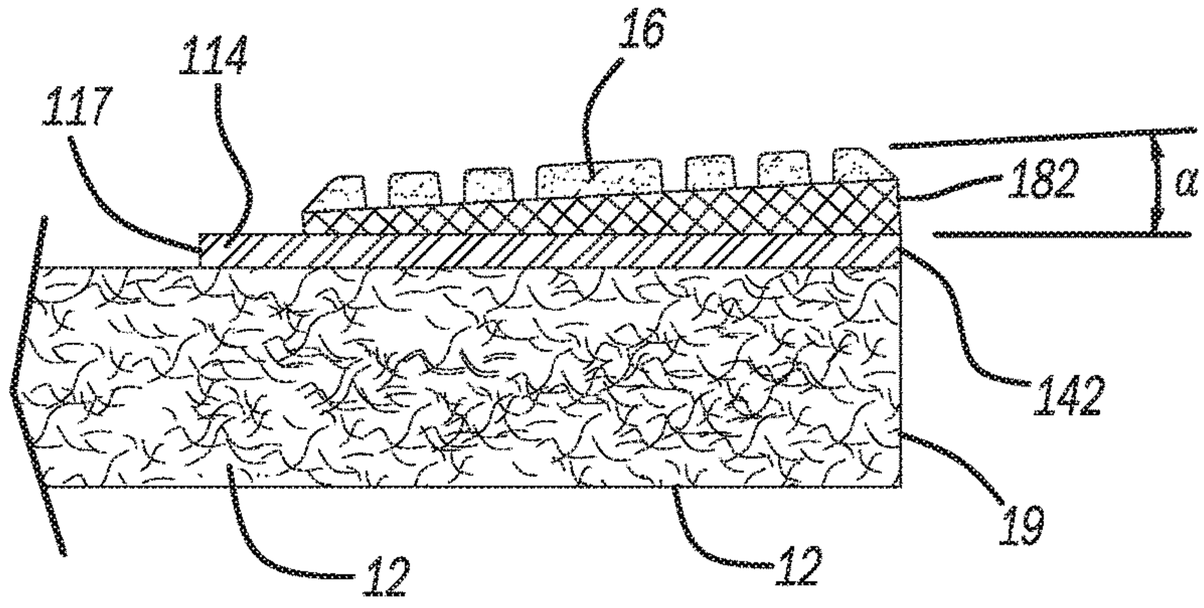


FIG - 14

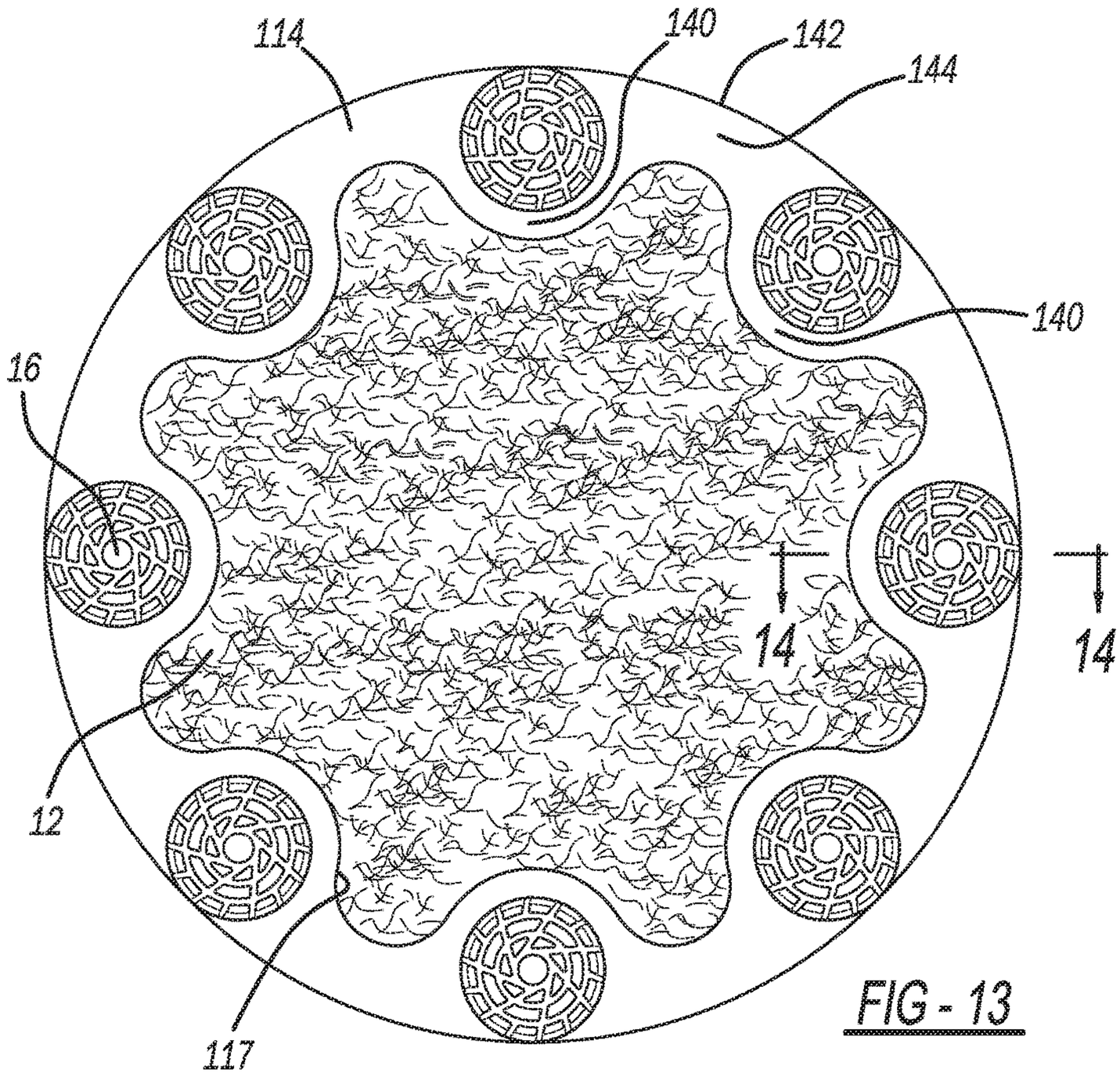


FIG - 13

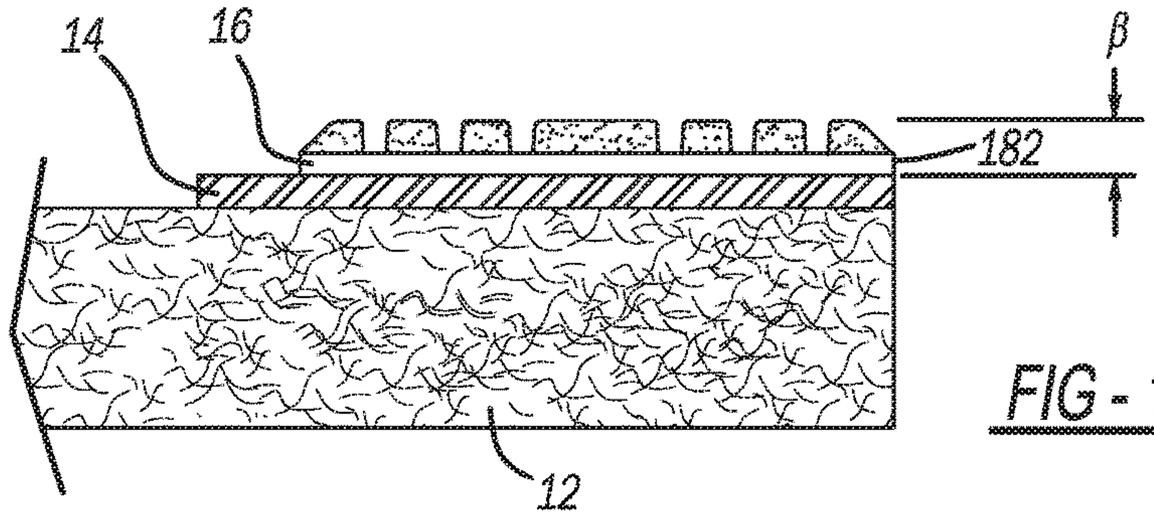


FIG - 15

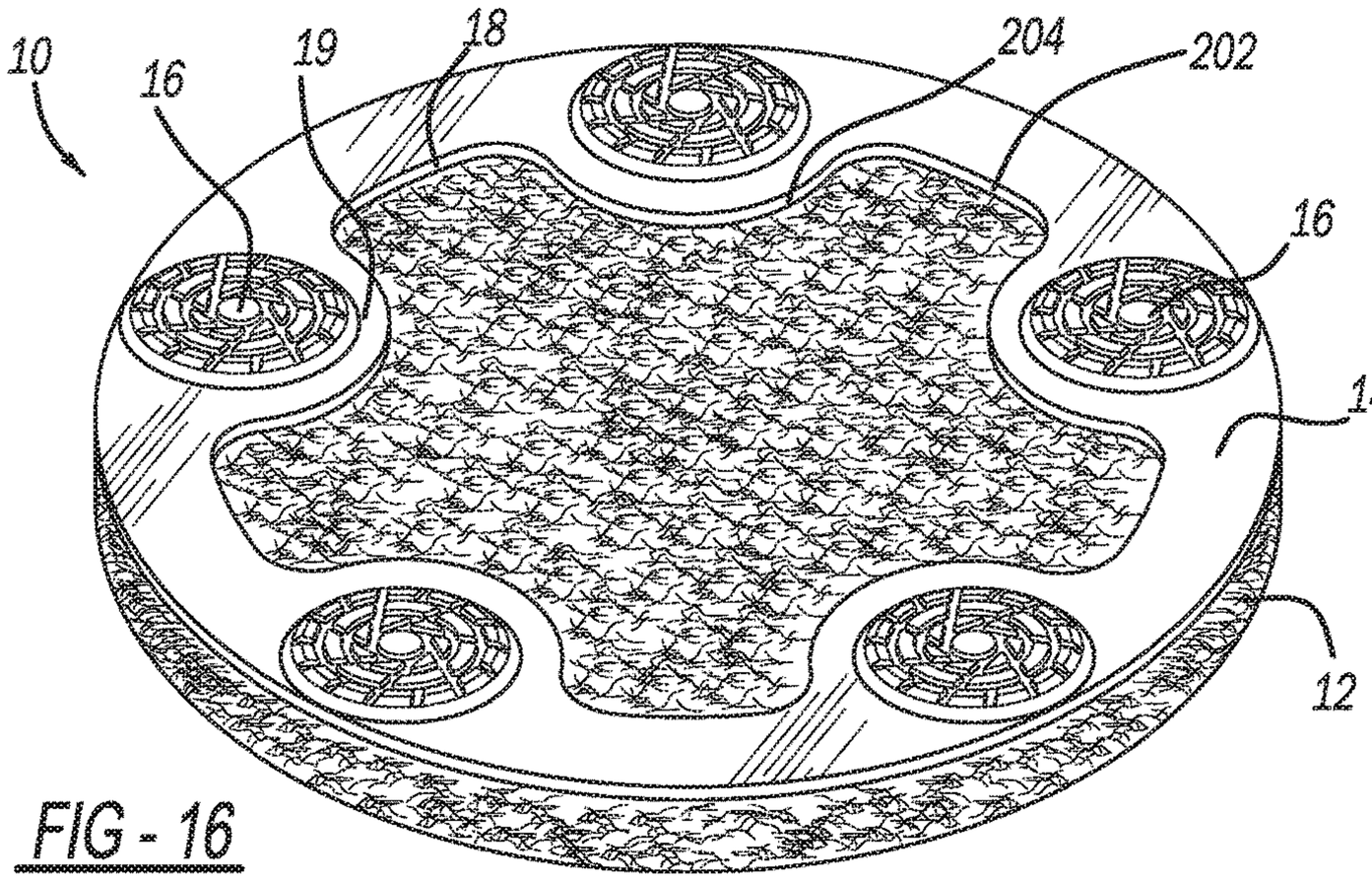

10
16
19
18
204
202
16
14
12

FIG - 16

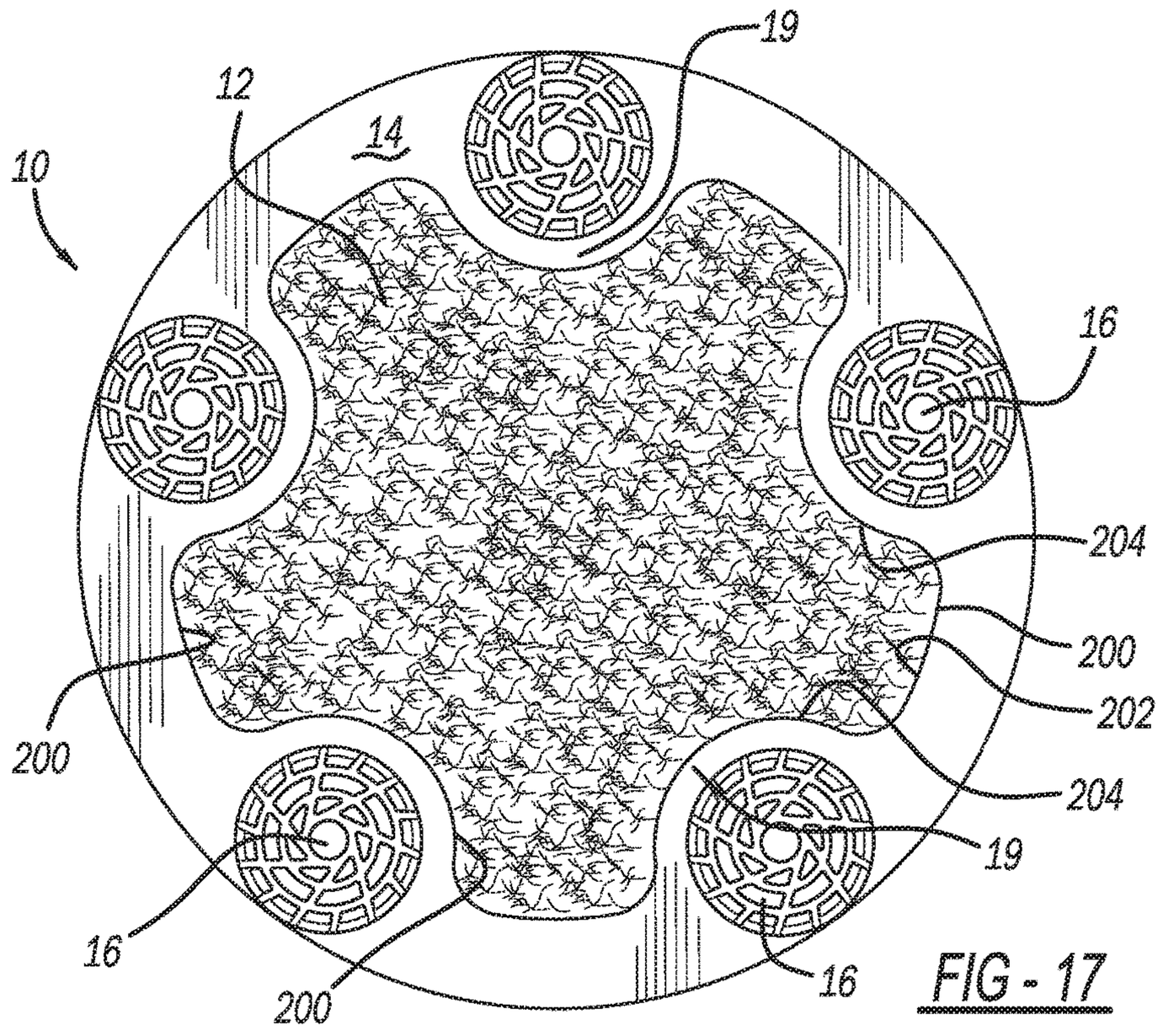

19
12
14
10
16
204
200
202
204
19
16
200
16

FIG - 17

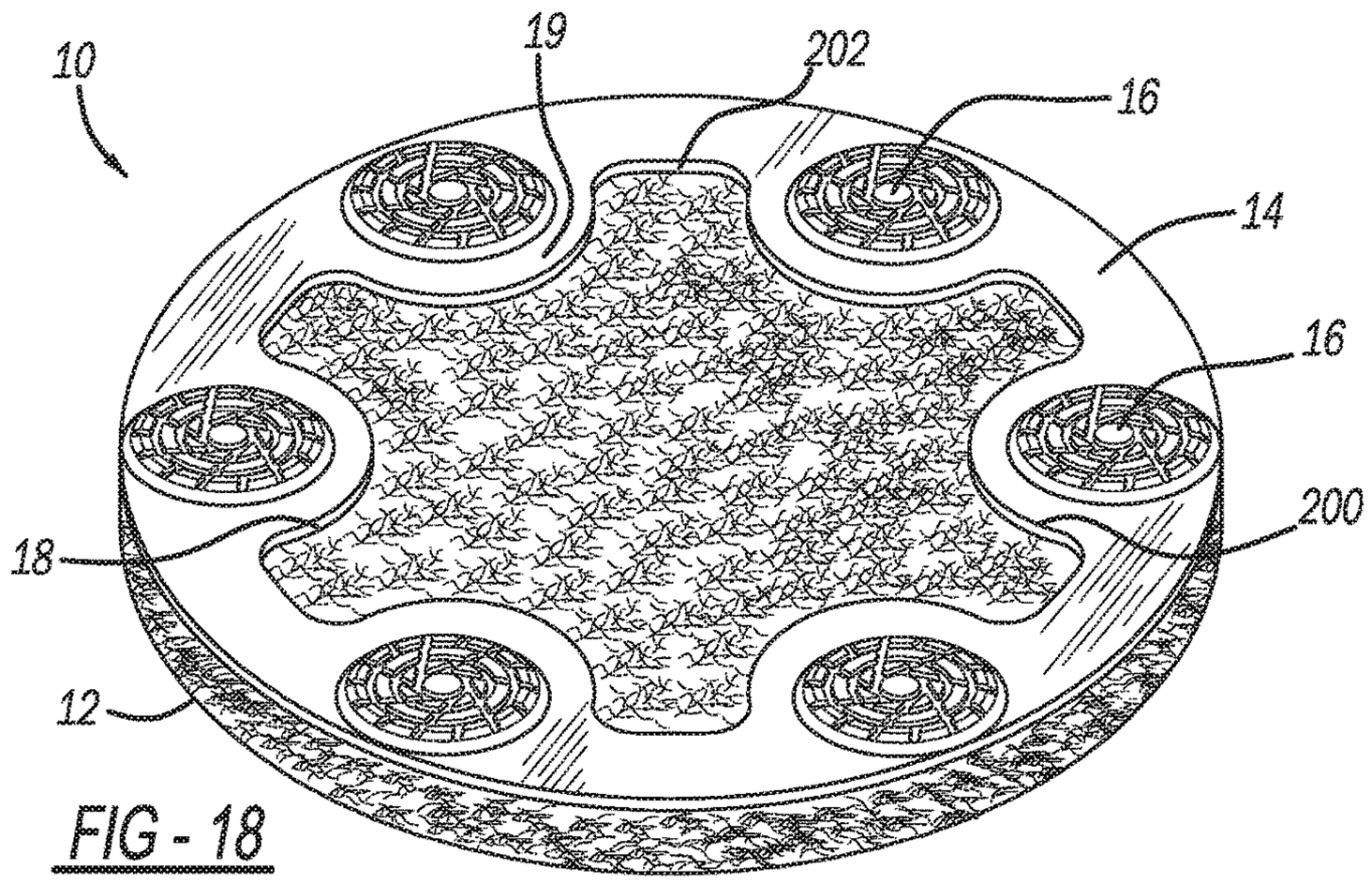


FIG - 18

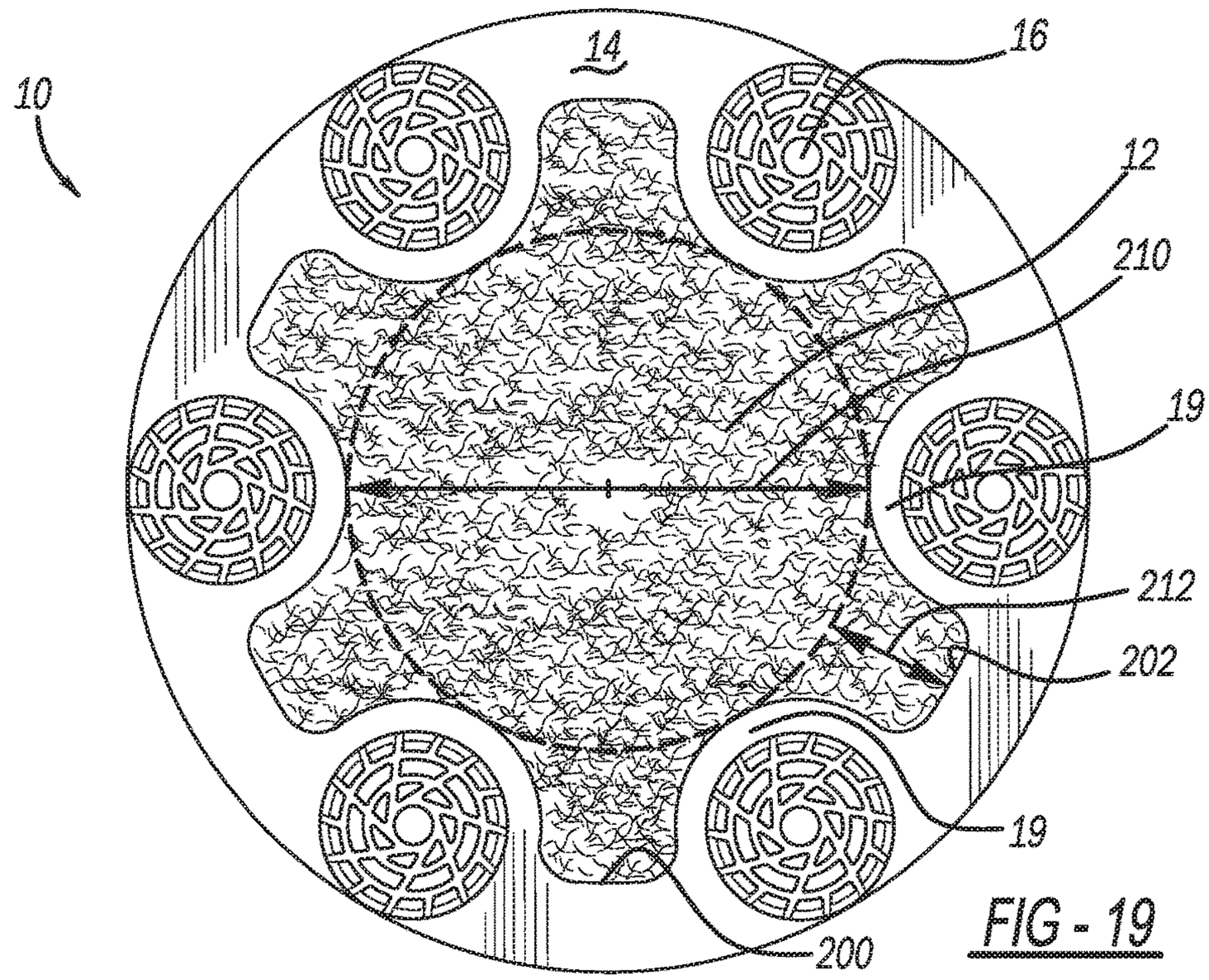


FIG - 19

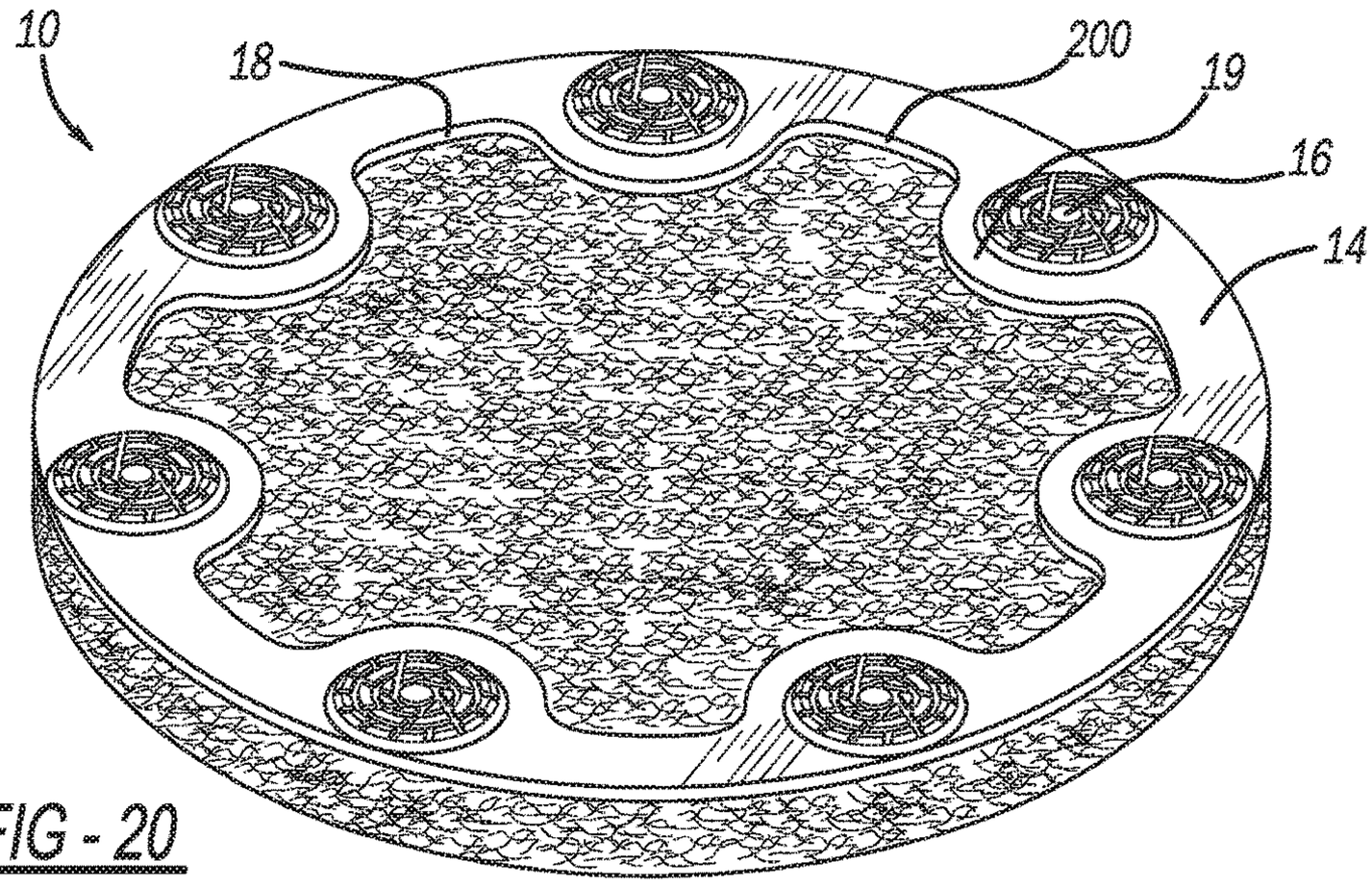


FIG - 20

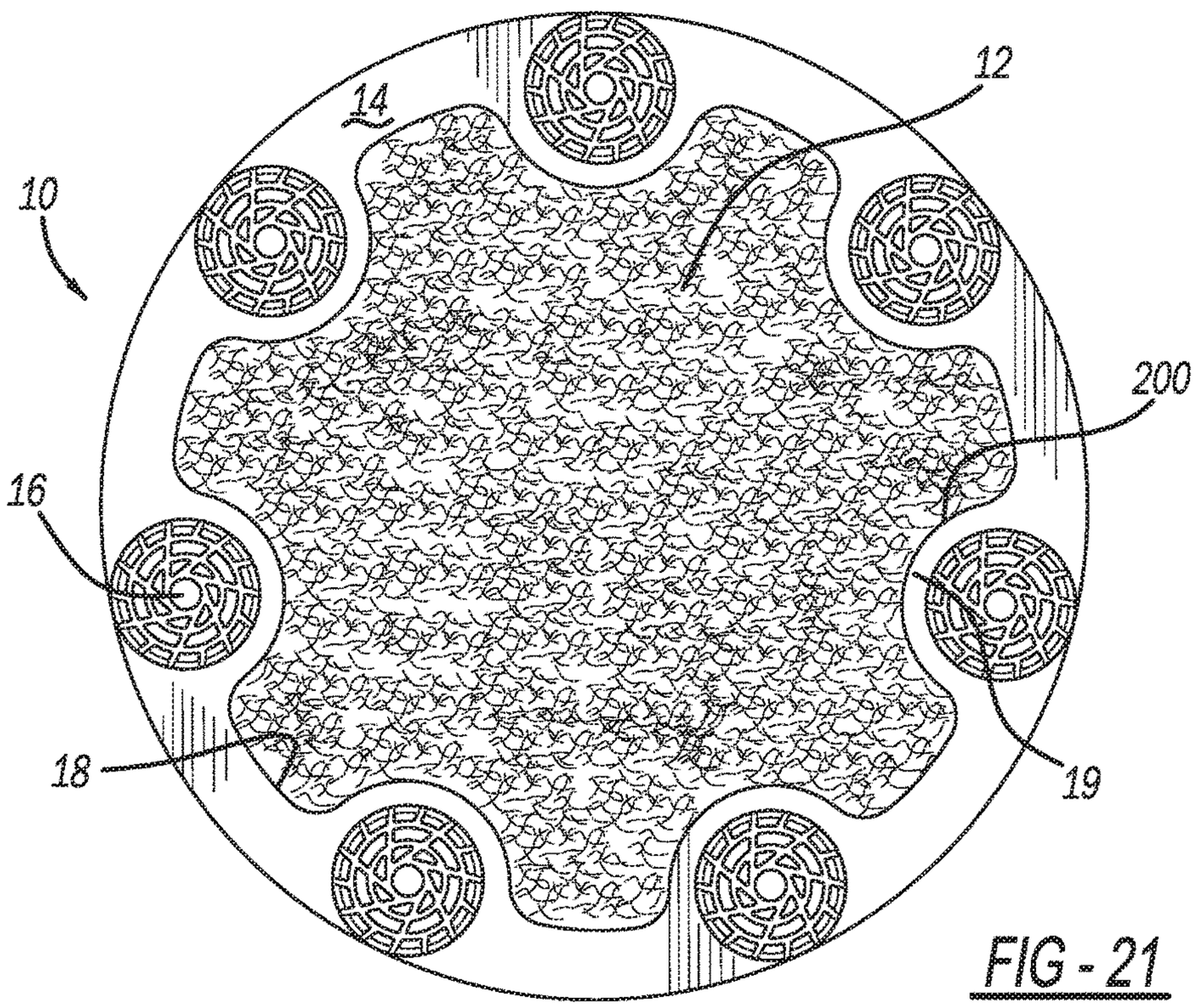


FIG - 21

POLISHING OR GRINDING PAD ASSEMBLY

CROSS-REFERENCE TO RELATED APPLICATIONS

This application is a continuation-in-part of PCT international Patent Application serial number PCT/US2016/053355, filed on Sep. 23, 2016, which claims the benefit of U.S. Provisional Application No. 62/232,123 filed on Sep. 24, 2015, which is incorporated by reference herein.

BACKGROUND AND SUMMARY

The disclosure relates generally to a pad assembly and more particularly to a floor polishing or grinding pad assembly.

It is known to use fibrous pads for polishing and grinding floors within industrial or commercial buildings. Such polishing or grinding pads are ideally suited for use on concrete, terrazzo, and natural (e.g., marble), engineered and composite stone floors. Examples of such pads and the powered machines used to rotate such can be found in the following U.S. patents and patent publication numbers: 2011/0300784 entitled "Flexible and Interchangeable Multi-Head Floor Polishing Disk Assemby" which was invented by Tchakarov et al. and published on Dec. 8, 2011; U.S. Pat. No. 9,174,326 entitled "Arrangement For Floor Grinding" which issued to Ahonen on Nov. 3, 2015; U.S. Pat. No. 6,234,886 entitled "Multiple Abrasive Assembly and Method" which issued to Rivard et al. on May 22, 2001; U.S. Pat. No. 5,605,493 entitled "Stone Polishing Apparatus and Method" which issued to Donatelli et al. on Feb. 25, 1997; and U.S. Pat. No. 5,054,245 entitled "Combination of Cleaning Pads, Cleaning Pad Mounting Members and a Base Member for a Rotary Cleaning Machine" which issued to Coty on Oct. 8, 1991. All of these patents and the patent publication are incorporated by reference herein.

Notwithstanding, improved floor polishing and grinding performance is desired. Furthermore, some of these prior constructions exhibit uneven wear in use which prematurely destroy the pads or cause inconsistent polishing or grinding.

In accordance with the present invention, a floor polishing or grinding pad assembly is provided. In one aspect, a polishing or grinding pad assembly employs a flexible pad, a reinforcement layer or ring, and multiple floor-contacting tools such as abrasive disks. In another aspect, the reinforcement layer includes a central hole through which a flexible pad is accessible and the pad at the hole has a linear dimension greater than a linear dimension of one side of the adjacent reinforcement layer. In yet another aspect, the reinforcement layer includes a wavy or undulating internal edge shape. A further aspect includes an inner ring edge having radially extending slots between pairs of radially enlarged tool mounting peaks. Still another aspect includes an insulator or spacer between a head of an abrasive tool and a reinforcement ring. A method of making and using a polishing or grinding pad assembly is also provided.

The present pad assembly is advantageous over traditional devices. For example, the present pad assembly advantageously allow greater floor contact with the pad within a centralized area generally surrounded by the disks, which is expected to improve polishing or grinding performance. Furthermore, the present pad assembly is considerably easier to install on a floor polishing or grinding machine than many prior constructions. The wavy, undulating, or alternating slotted and peaked inner edge of the ring allows different flexure characteristics during floor polishing or grinding, which also creating aesthetically pleasing ornamental designs. Moreover, the insulator or spacer feature reduces heat transfer from the abrasive tools to the reinforcement ring to reduce ring-to-pad adhesive degradation. Additional advantages and features of the present invention will be readily understood from the following description, claims and appended drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a bottom perspective view showing a first embodiment of the pad assembly;

FIG. **2** is a bottom elevational view showing the first embodiment pad assembly;

FIG. **3** is a fragmentary cross-sectional view, taken along line **3-3** of FIG. **1**, showing the first embodiment pad assembly;

FIG. **4** is a side elevational view showing an abrasive disk employed in the first embodiment pad assembly;

FIG. **5** is an exploded and bottom perspective view showing a portion of the first embodiment pad assembly;

FIG. **6** is a bottom perspective view showing a second embodiment of the pad assembly;

FIG. **7** is a bottom elevational view showing the second embodiment pad assembly;

FIG. **8** is a fragmentary cross-sectional view, taken along line **8-8** of FIG. **6**, showing a pad variation employed with the second embodiment pad assembly;

FIG. **9** is a bottom perspective view showing a third embodiment of the pad assembly;

FIG. **10** is a bottom elevational view showing the third embodiment pad assembly;

FIG. **11** is a fragmentary cross-sectional view, taken along line **11-11** of FIG. **9**, showing the third embodiment pad assembly;

FIG. **12** is a bottom perspective view showing a fourth embodiment of the pad assembly;

FIG. **13** is a bottom elevational view showing the fourth embodiment pad assembly;

FIG. **14** is a fragmentary cross-sectional view, taken along line **14-14** of FIG. **13**, showing the fourth embodiment pad assembly;

FIG. **15** is a fragmentary cross-sectional view, like that of FIG. **14**, showing a variation of the fourth embodiment pad assembly;

FIG. **16** is a bottom perspective view showing a fifth embodiment of the pad assembly;

FIG. **17** is a bottom elevational view showing the fifth embodiment pad assembly;

FIG. **18** is a bottom perspective view showing a sixth embodiment of the pad assembly;

FIG. **19** is a bottom elevational view showing the sixth embodiment pad assembly;

FIG. **20** is a bottom perspective view showing a seventh embodiment of the pad assembly; and

FIG. **21** is a bottom elevational view showing the seventh embodiment pad assembly.

DETAILED DESCRIPTION

A pad assembly **10** according to one embodiment is shown in FIGS. **1-5**. Pad assembly **10** may be used for grinding or polishing composite surfaces, such as a concrete floor. Pad assembly **10** includes a wear-resistant base pad **12**, which is preferably a flexible and deformable rubber or elastomeric polymeric material. Base pad **12** is generally circular, having a diameter of 150-360 mm and more pref-

erably 177 mm, and having a thickness of 10-30 mm and more preferably 10 mm. Of course, base pad **12** could be made in other sizes.

A reinforcement ring or layer **14** is secured to one side of base pad **12**, such as by adhesive. Reinforcement ring **14** is generally annular having a central opening defined by an inner edge **18**. Reinforcement ring **14** is cut or stamped as a flexible metallic material, preferably spring steel, having a thickness greater than zero and up to 1.0 mm, and more preferably 0.5 mm. Reinforcement ring or layer **14** reinforces and adds some stiffness and toughness to the outer portion of pad **12**, however, ring or layer **14** allows some flexibility to pad assembly **10** so it can flex with and follow any floor imperfections thereby producing uniform floor contact for polishing or grinding.

Inner edge **18** of reinforcement ring **14** has a wavy or undulating shape defining a central opening or hole which exposes a central surface **20** of base pad **12** therein. In this exemplary embodiment, inner edge **18** includes three radially extending slots **21** alternating with three partially circular peaks **19**. Thus, a slot is between each pair of peaks. The edge of each slot **21** has an entirely smoothly curved configuration with a laterally enlarged terminal end **23** of a larger dimension D outward of a smaller dimension d at closer necks **25**. Furthermore, slot **21** has a generally kieroid or mirrored S-shape when viewed like FIG. **2**. Base pad **12** and ring **14** preferably have aligned circular peripheral surfaces.

A plurality of abrasive tools or floor-contacting disks **16** are secured to the outer surface of the reinforcement ring **14**. In the example shown, abrasive tools **16** are approximately 2 inch disks of diamond particles in a polymeric resin matrix. In the example shown, three such abrasive tools or disks **16** are secured about the circumference of reinforcement ring **14**. Different sizes and different compositions of abrasive tools or disks **16** could be used. For example, disks **16** may include a metallic material. Alternately, the abrasive tools may have polygonal peripheral shapes.

A cylindrically shaped post **30** projects from a backside **31** of a laterally enlarged abrasive body **32** of each disk **16** in a longitudinal direction substantially parallel to a rotational axis of the pad assembly. The post is preferably integrally formed with the disk body as a single piece. Furthermore, post **30** projects through an aperture **33** pierced in ring **14**. Multiple of the apertures are equally spaced apart in the ring. A distal end of post **30** is deformed in a crimped manner to outwardly expand like a mushroom head thereby creating an enlarged head **34** which is laterally larger than aperture **33**. Thus, ring **14** is sandwiched and compressed between head **34** and backside **31** of each disk **16** to mechanically attach and secure the disks to the ring. Adhesive may additionally or instead be employed to attach and secure the disks to the ring with or without the posts, depending on the specific durability requirement and coarseness of the grit for grinding.

It is alternately envisioned that multiple parallel and spaced apart posts may project from each disk for insertion onto aligned apertures of the reinforcement ring. Moreover, it is alternately envisioned that one or more posts can have a generally polygonal shape, a flat side surface or a greater width in one lateral direction than another (e.g., a rectangle or oval). These alternate post configurations deter rotation of the disks relative to the attached reinforcement ring and base pad during grinding. It is alternately envisioned that a threaded bolt shaft or other mechanical fastener post may extend from the backside of the disk, however, some of the advantages of the integral post may not be achieved.

In the example shown, three such tools or disks **16** are secured to peaks **19** about the circumference of reinforcement ring **14** in an equally spaced apart manner. The posts may be solid or at least partially hollow. Furthermore, the ring apertures **33** are preferably circular but may alternately have one or more flat edges, or even be elongated slots in the inner edge **18** or outer edge of ring **14** to engage with a flat surface of the posts.

Many different types of floor-contacting, abrasive patterns may be employed on tools or disks **16**. In the exemplary pattern shown, at least 3 and more preferably 5 linearly elongated spokes **64** outwardly radiate from an innermost central groove or depression to a peripheral tapered edge, however, an innermost end of each spoke **64** is offset from a centerline.

Polishing pad **10** could be secured to a paddle of a rotating arm of an electric motor powered floor polishing or grinding machine. Such an attachment may be via a plurality of clips for releasably securing to each paddle and/or with hook-and-loop mechanical fasteners **49** (e.g. Velcro®) removably secured to base pad **12**. A plurality of the polishing pads would be secured for rotation about a center axis of the machine head. Alternate powered machines may be used to rotate pad assembly **10** such as those disclosed in the Background section hereinabove.

An insulator **50** acts as a nonconductive spacer between a bottom surface **51** of ring **14** and backside **31** of each tool or disk **16**. Each insulator **50** has an annular shape defined by circular inside and outside edges **52** and **53**, respectively. Inside edge **52** defines a central aperture and fits snuggly around post **30** in a concentric manner. Outside edge **53** is preferably aligned with the periphery of body **32** of disk **16**. Insulator **50** has generally flat top and bottom surfaces with a thickness therebetween of at least 2 mm, and more preferably of 3 mm. Furthermore, insulator **50** is molded from a fiberglass material which includes glass fibers in a polymer. The insulators advantageously reduce heat transferring from metallic bodies **32** of disks **16** to reinforcement ring **14** during floor workpiece abrasion, especially when dry (e.g., without a liquid polish or lubricant) rotation is being performed.

Reference should now be made to FIGS. **6-8** for another embodiment of pad assembly **10**. A rubber or elastomeric polymer, circular pad **12**, metallic reinforcement ring **14**, tool disks **16** and insulator **50** are essentially as provided hereinabove. It is noteworthy that an inner edge **61** defining the hole of ring **14** is circular and has a diameter or linear dimension x which is larger than a linear dimension y of a solid section of ring **14** which is adjacent to one side of the hole. More preferably, hole dimension x is a least twice as large as ring dimension y and more preferably, dimension x is 6 inches. The hole relationship of x>y is expected to improve floor contact by the fibrous central portion of pad **12** within the hole defined by internal edge **61** of ring **14**.

At least three and more preferably five tools or disks **16** are attached to a lower, floor-facing surface of reinforcement ring or layer **14**. Each disk has a diameter of 1-2.5 inches and more preferably 2 inches. This disk size and quantity on pad assembly **10** is ideally suited for floor-grinding. Notwithstanding, the present dimensional relationships, and the arrangement and quantity of disks about the ring, also have ornamental aspects.

Alternately, FIG. **8** illustrates pad **12** made of fibers impregnated with polymeric and diamond materials to provide a floor abrading surface through opening **18**. Alternately, pad may be a polymeric foam or felt material.

FIGS. **9-11** show another embodiment of pad assembly **10**. This configuration is the same as the embodiment of FIG. **6**, with insulator **50**, except that there are eight of the disks **16** mounted to lower surface **74** of reinforcement ring **14**. Disks **16** are all equilaterally spaced apart from each other and are also equally spaced apart from a centerline **88** of pad **12**. This configuration is ideally suited for a final polishing operation although, it should also be appreciated that there are ornamental aspects to this embodiment as well.

Reference is now made to FIGS. **12-15**. This exemplary embodiment employs a fibrous (or alternately rubber, elastomeric polymer, polymeric foam or felt) pad **12** and disks **16** like that of FIG. **1**. A reinforcement ring or layer **114**, however, has a wavy or undulating inner edge **117** defining a hole therein to expose a central portion of fibrous pad **12**. Ring **114** has peaks **140**, with a greater radial distance between an outer peripheral edge **142** and inner edge **117** of ring **114**. Spaced between adjacent peaks **140** are radially extending slots and aligned ring valleys **144** where the radial dimension or thickness of the ring is less between outer peripheral edge **142** and inner edge **117** of ring **114**. This wavy or undulating ring shape maximizes the center hole area, and thereby floor-to-fibrous pad contact. The hole is essentially surrounded by the abrading tools or disks **16**. Nevertheless, there are also ornamental aspects to this design.

While the bottom or working disk nominal surface-to-ring and pad angle α is preferably offset angled by 2-10 degrees, and more preferably at least 4 degrees, (see FIG. **14**), it is alternately envisioned in FIG. **15** that such could be given a parallel planar relationship of β instead although some of the functional advantages may not be realized. Both of the FIGS. **14** and **15** configurations have the outermost peripheral edge **182** of each disk **16** substantially aligned with peripheral edges **142** of ring **114** and **146** of pad **12**. Each radially extending slot between peaks **140** of this exemplary configuration has a smoothly continuous curve with the most outward terminal ends being narrower than the tapered side walls creating the peaks. At least three, and more preferably eight, abrasive tools or disks are employed. No insulators are used but such may alternately be provided. The disks are adhesively bonded to the ring, although the crimped posts may alternately be used. It should be appreciated that the floor-contacting surfaces of the disks may be either angled or parallel β relative to the floor-facing surfaces of the ring or pad for any of the embodiments herein.

FIGS. **16** and **17** illustrate a five abrasive tool or disk **16** version of the pad assembly **10**. It is like that of any of the prior embodiments, with or without insulators and with or without angled abrading surfaces on the disks. However, inner edge **18** of ring **14** has radially extending slots **200** with flat terminal ends **202** and parallel side walls **204** defining at least sections of the adjacent peaks **19**. The disks are secured to the radially enlarged and partly circular peaks. A radius is located between end **202** and each adjacent side wall **204**.

Referring to FIGS. **18** and **19**, this embodiment pad assembly **10** is like that of FIG. **16** but there are six abrasive tools or disks **16** with six radially extending slots **200** therebetween. An inner ring diameter **210** is preferably 152.4 mm, and dimension **212** between diameter **210** and end **202** is preferably 38.1 mm. Thus, dimension **212** radially extends at least $\frac{1}{5}^{th}$ of diameter **210** and more than half a diameter of each disk **16**.

The FIGS. **20** and **21** embodiment pad assembly **10** is essentially the same as that of the preceding version. With this one, however, seven abrasive tools or disks **16** are attached to metallic reinforcement ring **14** which has a wavy or undulating inner edge **18**. Inner edge **18** defines 7 slots **200** between seven disk-mounting peaks **19**. Again, insulators, posts and/or angled abrading disk surfaces may be employed with this or any of the other embodiments disclosed herein.

While various embodiments have been disclosed, it should be appreciated that additional variations of the pad assembly are also envisioned. For example, while preferred dimensions have been disclosed hereinabove, it should alternately be appreciated that other dimensions may be employed; for example a peripheral pad diameter of at least 10 inches may be employed and disk diameters of 0.5-2.5 inches may also be employed. Moreover, circular peripheral shapes for the pad, reinforcement ring and disks are preferred, however, other arcuate or even generally polygonal peripheral shapes may be used although certain of the present advantages may not be fully realized. While certain materials have been disclosed it should be appreciated that alternate materials may be used although all of the present advantages may not be fully achieved. It is also noteworthy that any of the preceding features may be interchanged and intermixed with any of the others; by way of example and not limitation, any of the disclosed reinforcement ring shapes and/or sizes may be employed with or without angular disks, with any of the aforementioned disk patterns and/or with any of the disk-to-disk positioning. Accordingly, any and/or all of the dependent claims may depend from all of their preceding claims and may be combined together in any combination. Variations are not to be regarded as a departure from the present disclosure, and all such modifications are entitled to be included within the scope and sprit of the present invention.

The invention claimed is:

1. A pad assembly comprising:

a pad including an upper surface, a floor-facing surface and a peripheral surface; and

a reinforcement layer attached to the floor-facing surface of the pad, and the reinforcement layer including an internal edge defining a hole therethrough;

wherein the internal edge has a repeating undulating shape including radially oriented peaks with valleys located in between adjacent pairs of the peaks.

2. The pad assembly of claim **1**, further comprising disks attached to a floor-facing surface of the reinforcement layer at the peaks.

3. The pad assembly of claim **2**, wherein the outer peripheral surface of the pad, and peripheral surfaces of the reinforcement layer and the disks, are all circular, and the pad is flexible.

4. The pad assembly of claim **2**, wherein each disk has a floor-contacting nominal surface which is angularly offset by at least two degrees relative to the floor-facing surface of the reinforcement layer.

5. The pad assembly of claim **2**, wherein at least one of the disks includes a floor-abrading surface including channels outwardly radiating between a centerline and periphery of the disk, inner ends of the radiating channels being offset from a disk centerline.

6. The pad assembly of claim **1**, further comprising floor-abrading tools attached to the reinforcement layer, which is metallic, at the peaks.

7. The pad assembly of claim **6**, further comprising a post integrally extending from a backside of each of the tools, the posts being crimped to the reinforcement layer which is flexible.

8. The pad assembly of claim 1, wherein there are at least three peaks, and the undulating shape is arcuate, with a central area of the pad being exposed through the hole of the reinforcement layer such that a linear dimension of the central area within the hole is greater than a linear dimension of one side of the reinforcement layer between the hole and a periphery thereof.

9. The pad assembly of claim 1, further comprising an insulator disposed between an abrasive body of a tool and the reinforcement layer to which the tool is attached, the reinforcement layer being a flexible metallic material.

10. A pad assembly comprising:

a fibrous pad including an upper surface, a floor-facing surface and a peripheral surface; and

a reinforcement layer attached to the floor-facing surface of the pad, and the reinforcement layer including an internal edge defining a hole therethrough;

wherein the internal edge has a repeating undulating shape including at least four radially oriented peaks with valleys located in between adjacent pairs of the peaks.

11. The pad assembly of claim 10, further comprising disks attached to a floor-facing surface of the reinforcement layer at the peaks.

12. The pad assembly of claim 11, wherein the outer peripheral surface of the fibrous pad, and peripheral surfaces of the reinforcement layer and the disks, are all circular, and the pad is flexible and includes diamond abrasive particles.

13. The pad assembly of claim 11, wherein each disk has a floor-contacting nominal surface which is angularly offset by at least two degrees relative to the floor-facing surface of the reinforcement layer.

14. The pad assembly of claim 11, wherein at least one of the disks includes a floor-abrading surface including channels outwardly radiating between a centerline and periphery of the disk, the pattern further including circular channels intersecting the curved and radiating channels, and the disk including a solid center without an aperture therein, inner ends of the radiating channels being offset from a disk centerline, and the disks all including a polymeric material which is adhesively bonded to the reinforcement layer.

15. The pad assembly of claim 11, wherein at least one of the disks includes a floor-abrading pattern including at least ten concentric circles, with all of the disks adhesively bonded to the reinforcement layer.

16. The pad assembly of claim 10, wherein there are at least eight peaks, and the undulating shape is arcuate, with a central area of the pad being exposed through the hole of the reinforcement layer such that a linear dimension of the central area within the hole is greater than a linear dimension of one side of the reinforcement layer between the hole and a periphery thereof.

17. The pad assembly of claim 10, further comprising fasteners coupled to a top surface of the pad adapted for removable attachment to paddles of a rotating floor polishing or grinding machine.

18. A pad assembly comprising:

a flexible and rotatable pad including an upper surface, a floor-facing surface and a peripheral surface;

a flexible reinforcement ring attached to the floor-facing surface of the pad, and the reinforcement ring including a circular external edge and an internal edge defining a hole therethrough;

the internal edge including alternating radially extending slots and radially enlarged peaks, defining an opening through which a portion of the pad is exposed; and

floor-contacting abrasive tools attached to the reinforcement ring.

19. The pad assembly of claim 18, further comprising a post extending from a backside of each of the tools and being attached through a hole in the reinforcement ring, the post extending through a central aperture in an insulator, and multiples of the insulator being equally spaced apart on the reinforcement ring.

20. The pad assembly of claim 19, wherein the post is integral with the associated tool as a single piece.

21. The pad assembly of claim 18, wherein the tools are circular disks attached to a floor-facing surface of the reinforcement ring at the peaks located between the slots.

22. The pad assembly of claim 18, wherein there are at least three of the peaks, and the internal edge shape of the ring is arcuate, with a central area of the pad being exposed through the opening of the reinforcement ring such that a linear dimension of the central area within the opening is greater than a linear dimension of one side of the reinforcement ring between the opening and a periphery thereof.

23. The pad assembly of claim 18, wherein the pad is fibrous and includes diamond abrasive particles.

24. The pad assembly of claim 18, wherein each of the slots of the internal edge of the reinforcement ring includes a flat terminal end wall bordered by at least partially straight side walls.

25. The pad assembly of claim 18, wherein each of the slots of the internal edge of the reinforcement ring includes an arcuate terminal end wall bordered by inwardly opening tapered side walls.

26. The pad assembly of claim 18, wherein each of the slots of the internal edge of the reinforcement ring includes a narrower neck dimension which is less than a lateral dimension adjacent a terminal end wall.

27. The pad assembly of claim 18, wherein each of the slots of the internal edge of the reinforcement ring includes a continuously curved shape with at least three of the slots being present in the reinforcement ring.

28. A pad assembly comprising:

a flexible pad including an upper surface, a floor-facing lower surface and a peripheral surface;

a flexible reinforcement layer attached to a bottom surface of the pad;

abrasive tools attached to a floor-facing surface of the reinforcement layer; and

an insulator located between a section of each of the tools and the reinforcement layer;

wherein the insulator includes a circular peripheral edge and a central hole.

29. The pad assembly of claim 28, wherein:

the peripheral surface of the pad is circular;

a periphery of the reinforcement layer is circular and substantially aligned with the peripheral surface of the pad; and

the tools are all substantially equally spaced away from a centerline of the pad.

30. The pad assembly of claim 28, wherein there are at least three of the tools which are circular disks, attached to the reinforcement layer.

31. The pad assembly of claim 28, wherein each of the tools has a floor-contacting nominal surface which is angularly offset by at least two degrees relative to the floor-facing surface of the reinforcement layer.

32. The pad assembly of claim 28, wherein each of the tools is a circular disk having a floor-contacting nominal

surface which is angularly offset by at least four degrees relative to the floor-facing surface of the reinforcement layer.

33. The pad assembly of claim **28**, further comprising an internal edge of the reinforcement layer being circular such that the reinforcement layer has an annular shape.

34. The pad assembly of claim **28**, further comprising an internal edge of the reinforcement layer has an arcuately wavy shape including the peaks, and the pad being rotatable about a center axis thereof.

35. The pad assembly of claim **28**, wherein the insulator is fiberglass.

36. The pad assembly of claim **28**, further comprising an integrally formed post extending from a backside of each of the tools, the integrally formed post extending through a hole in the insulator.

37. The pad assembly of claim **28**, wherein the reinforcement layer is metallic, there are multiples of the insulator which are spaced apart from each other and aligned with the tools, the insulators deter heat transfer from the tools to the reinforcement layer, and the tools and the reinforcement layer are metallic.

38. The pad assembly of claim **28**, further comprising fasteners coupled to the top surface of the pad adapted for removable attachment to a rotating floor polishing or grinding machine.

39. The pad assembly of claim **28**, being a machine-powered floor polishing pad assembly.

40. The pad assembly of claim **28**, being a machine-powered floor grinding pad assembly.

41. The pad assembly comprising:

a flexible and rotatable pad including a circular peripheral surface;

a metallic reinforcement ring with a substantially circular peripheral surface;

workpiece-abrading tools coupled to the reinforcement ring;

spacers located between the tools and the reinforcement ring, the spacers including a polymeric or fiberglass material;

the spacers being spaced apart from each other and aligned with the tools; and

an integrally formed post extending from a backside of each of the tools, the integrally formed post extending through a hole in an aligned one of the insulators.

42. The pad assembly of claim **41**, wherein the spacers each include a circular peripheral edge and substantially flat top and bottom surfaces.

43. The pad assembly of claim **41**, further comprising a fastener extending from a backside of each of the tools, the fastener extending through a hole in an aligned one of the insulators.

44. The pad assembly of claim **41**, wherein a distal end of the post is crimped to the reinforcement ring which is flexible.

45. The pad assembly of claim **41**, further comprising an internal edge of the reinforcement ring being circular such that the reinforcement ring has an annular shape.

46. The pad assembly of claim **41**, further comprising an internal edge of the reinforcement ring having an arcuately wavy shape including peaks and valleys, the reinforcement ring being linearly larger at the peaks than at the valleys, and one of the tools being located within each of the peaks.

47. The pad assembly of claim **41**, being a machine-powered floor polishing pad assembly.

48. The pad assembly of claim **41**, being a machine-powered floor grinding pad assembly.

49. A method of making an abrasive pad assembly, the method comprising:

(a) attaching a metallic and flexible reinforcement layer adjacent to a periphery of a thicker, flexible and rotatable pad on a workpiece-facing surface of the pad;

(b) locating insulators against a workpiece-facing side of the reinforcement layer;

(c) attaching workpiece abrading tools to the reinforcement layer or insulators such that the insulators are sandwiched between at least a lateral enlarged section of each of the tools and the reinforcement layer;

(d) inserting a post extending from a backside of each of the tools through a central hole in an associated one of the insulators; and

(e) securing the post to a top surface of the reinforcement layer.

50. The method of claim **49**, wherein:

the reinforcement layer has an internal edge through which the pad is exposed;

the insulators are fiberglass and/or polymeric annular spacers; and

the pad assembly is a floor-polishing or grinding pad assembly.

51. A pad assembly comprising:

a flexible pad including an upper surface, a floor-facing lower surface and a peripheral surface;

a flexible reinforcement layer attached to a bottom surface of the pad;

abrasive tools attached to a floor-facing surface of the reinforcement layer;

an insulator located between a section of each of the tools and the reinforcement layer; and

a fastener extending from a backside of at least one of the tools, the fastener extending through a hole in the insulator.

52. The pad assembly of claim **51**, wherein:

the peripheral surface of the pad is circular;

a periphery of the reinforcement layer is circular and substantially aligned with the peripheral surface of the pad; and

the tools are all substantially equally spaced away from a centerline of the pad.

53. The pad assembly of claim **51**, wherein there are at least three of the tools which are circular disks, attached to the reinforcement layer.

54. The pad assembly of claim **51**, further comprising an internal edge of the reinforcement layer being circular such that the reinforcement layer has an annular shape.

55. The pad assembly of claim **51**, further comprising an internal edge of the reinforcement layer has an arcuately wavy shape, and the pad being rotatable about a center axis thereof.

56. The pad assembly of claim **51**, wherein the insulator includes a circular peripheral edge aligned with a circular periphery of the associated tool.

57. The pad assembly of claim **51**, wherein the insulator has substantially flat top and bottom surfaces, the reinforcement layer contacting against the top surface of the insulator.

58. The pad assembly of claim **51**, wherein the insulator is fiberglass.

59. The pad assembly of claim **51**, wherein the fastener includes an integrally formed post extending from a backside of the at least one of the tools.

60. The pad assembly of claim **51**, wherein the reinforcement layer is metallic, there are multiples of the insulator which are spaced apart from each other and aligned with the

tools, the insulators deter heat transfer from the tools to the reinforcement layer, and the tools and the reinforcement layer are metallic.

61. The pad assembly of claim **51**, being a machine-powered floor polishing pad assembly.

62. The pad assembly of claim **51**, being a machine-powered floor grinding pad assembly.

* * * * *